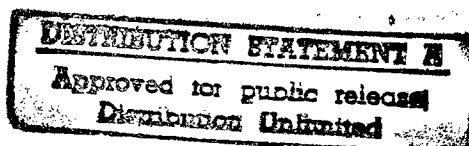


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CONTENTS

30 December 1992

Aerospace Medicine

- Neurotransmitter Interactions in Specific and Nonspecific CNS Structures in Relation to Locomotor Relaxation and Graded Visceral Stimulation
[A.S. Dmitriyev, M.Yu. Tayts, et al.; *DOKLADY AKADEMII NAUK BSSR*, Vol 35 No 8, Aug 91] 1

Biochemistry

- Effect of Terminal Modification of Oligonucleotides on Their Stability in Mycoplasma Cells
[V. V. Vlasov, V. F. Zarytova, et al.; *BIOPOLIMERY I KLETKA*, Vol 7 No 5, Sep-Oct 91] 2

Biotechnology

- Identification of Reference Strains of *Leishmania major*, *L. turanica*, and *L. gerbilli* Using Polymerase Chain Reaction With Universal Marker
[S. A. Bulat, M. V. Strelkova, et al.; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 3
- Efficacy of Combined Preparation of *Bacillus sphaericus* and *Bacillus thuringiensis* H-14 Against Blood-Sucking Mosquito Larvae
[A. A. Chabanenko, Ye. N. Bogdanova, et al.; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 3

Environment

- Report on Radiation Conditions in Kazakhstan [S. Tleubergenov, *BIRLESU*, No 28, 1992] 4
- Dolphins To Be Used in EKOBAROS Program To Clear Baltic Mines
[SANKT PETERBURGSKIYE VEDOMOSTI 15 May 92] 6

Epidemiology

- Data on Spread of *Culex pipiens* Throughout USSR
[N. Ya. Markovich, S. N. Zarechnaya; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 7
- Impact of Socioeconomic and Ecological Conditions on Tick-Borne Encephalitis Morbidity in Inhabited Rayons
[I. N. Voinov and V. I. Votyakov; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 11
- Ecology of *Echinococcus multilocularis* (Leuckart, 1863) and *E. granulosus* (Batsch, 1786) on Kamchatka Peninsula
[N. A. Tranbenkova; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 14
- Possibility of Opisthorchiasis Focus Formation in Lower Reaches of Angara
[O. P. Zelya and I. V. Gerasimov; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 17
- Decrease in Humoral Immunity to Tick-Borne Encephalitis Virus in Western Urals Population
[R. Z. Kuzyayev, L. K. Yaroshenko, et al.; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 18
- Search for Novel Anti-Parasite Agents. 10. Synthesis and Toxicologic and Anti-Malarial Properties of Some Nitrogen-Containing Heterocycles With 4-(4-Alkylpiperazinyl-1) Phenylamine Substituent (Quinoprazine)
[F. S. Mikhaylitsyn, N. P. Kozyreva, et al.; *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI*, No 1, Jan-Feb 92] 18

| | |
|--|----|
| Epidemic Manifestation of Natural Foci of Tick-Borne Encephalitis in the Maritime Kray. Report 2. Spatial Differences of the Seasonality of Tick-Borne Encephalitis [G. N. Leonova, Ye. E. Borisovets; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 19 |
| Basic Features of the Epidemiology of Lyme Disease in the Northwestern USSR [E. I. Korenberg, R. I. Kuznetsova, et al.; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 23 |
| Morbidity Associated With Tick-Borne Relapsing Fever in the Western Pamirs [I. S. Vasilyeva, A. S. Yershova, et al.; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 26 |
| Features of the Epidemic Activation of the Natural Focus of Zoonotic Cutaneous Leishmaniasis in Locales of Sympatric Incidence of Leishmania Major, L. Turanica, and L. Gerbilli [L. N. Yeliseyev, M. V. Strelkova, et al.; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 29 |
| Identification of Foci of Opisthorchiasis in Belorussia [L. V. Skripova, N. A. Romanenko, et al.; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 35 |
| Evaluating the Situation With Regard to Opisthorchiasis in the Area of the Irtysh-Karaganda Canal [Ye. G. Sidorova, Yu. V. Belyakova, et al.; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 38 |
| Tickborne Encephalitis [S. P. Chunikhin; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 40 |
| Transmission of Tickborne Encephalitis With Cow's Milk [L. A. Vereta, V. Z. Skorobrekha, et al.; <i>MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI</i> , No 3, May-Jun 91] | 43 |

Genetics

| | |
|--|----|
| Determination of Replicating Activity of Recombinant Plasmids, Containing the SV40 Virus Eukaryotic Regulator Region, in Mammalian Cell Cultures [S. M. Landau, A. V. Tikhonov, et al.; <i>BIOPOLIMERY I KLETKA</i> , Sep-Oct 91] | 46 |
| Cytogenetic Changes in Peripheral Leukocytes of Patients With Chernobyl-Related Radiation Injuries [M.A. Pilinskaya, A.M. Shemetun, et al.; <i>TSITOLOGIYA I GENETIKA</i> , Vol 25 No 4, Jul-Aug 92] | 46 |
| Genetics of Sunflowers Regenerated From Somatic Cell Cultures [T.F. Petrova, I.P. Voronina, et al.; <i>TSITOLOGIYA I GENETIKA</i> , Vol 25 No 4, Jul-Aug 92] | 46 |
| Introduction of RAS Oncogene Into Antibody-Producing Hybridoma [Ye.V. Belkina, Ye.I. Deryugina, et al.; <i>GEMATOLOGIYA I TRANSFUZIOLOGIYA</i> , Vol 36 No 8, Aug 91] | 46 |

Medicine

| | |
|---|----|
| Prevention of Wound Infection by Gentacycol in Gunshot Limb Fractures: In Vitro and Animal Studies [Yu.G. Shaposhnikov, A.I. Kaveshnikov, et al.; <i>ORTOPEDIA, TRAVMATOLGOYA I PROTEZIROVANIYE in Russian</i> No 6, Jun 91] | 47 |
| Efficacy of Fibronectin and Emoxipin in Ocular Burns [Ye.V. Chentsova, A.A. Shvedova, et al.; <i>OFTALMOLOGICHESKIY ZHURNAL</i> , No 3, Mar 91] | 47 |
| Stable Recovery of Endogenous Insulin Production in Experimental Insulin-Dependent Diabetes [B.A. Kudryashov, A.M. Ulyanov; <i>VOPROSY MEDITSINSKOY KHIMII</i> , Vol 37 No 4, Jul-Aug 91] | 47 |

Pharmacology, Toxicology

| | |
|--|----|
| Effect of Stress Factors on the Activity of Carboxypeptidase H on Rat Brain Regions [A. N. Vernigora, M. T. Gengin, et al.; <i>UKRAINSKIY BIOKHIMICHESKIY ZHURNAL</i> , Vol 64 No 2, Mar-Apr 92] | 48 |
| Immunomodulating Effect of Ecdysterones [G. N. Fomovskaya, A. G. Berdyshev, et al.; <i>UKRAINSKIY BIOKHIMICHESKIY ZHURNAL</i> , Vol 64 No 2, Mar-Apr 92] | 48 |
| Several Aspects of the Effect of Licorice Root Extract on Liver Parenchyma in Experimental Animals [Sh. M. Karimov, M. Yu. Lipchenko; <i>IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA BIOLOGICHESKIKH NAUK</i> , No 4, Jul-Aug 91] | 48 |

Physiology

- Effect of Met-Enkephalin and β -Endorphin on Conditioned Response in Hedgehogs
[T.N. Sollertinskaya, M. Obidova; *FIZIOLOGICHESKIY ZHURNAL SSSR IMENI I.M. SECHENOVA*, Vol 77 No 10 Oct 91] 49
- Effects of Oxymethacil on Microcirculation and Discharge Rate of Cat Cortical Neurons in Acute Paraoson Poisoning
[A.L. Kamenev, M.O. Samoylov, et al.; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 49
- Central and Peripheral μ - and δ -Opiate Receptors in Antiarrhythmic Mechanism of Action of Enkephalins
[L.N. Maslov, Yu.B. Lishmanov; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 49
- Stress Adaptation Enhances Stability of Cardiocyte Nuclear DNA by Nuclear Accumulation of Heat Shock Proteins
[I.Yu. Malyshev, A.V. Zamotrinskiy, et al.; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 49
- Repeated Stress and Dalargin Effects on Proliferation of Gastric Mucosa
[S.S. Timoshin, S.I. Shvets, et al.; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 50
- Modulation of Brain Catecholamine Levels by Anti-Dopamine β -Monooxygenase Antibodies
[A.S. Pogosyan, A.S. Boyadzhan, et al.; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 50
- Repair of Hepatic Mitochondrial Membranes by Phosphatidylcholine Liposomes
[O.V. Dobrynina, V.L. Migushina, et al.; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 50
- Pharmacologic Modulation of Opioid Analgesia
[V.N. Zhukov, Yu.Yu. Troyan; *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY*, Vol 112 No 8, Aug 91] 50
- Taurine Modulation of Neuronal Potassium Ion Currents
[A.I. Vislobokov, A.G. Kopylov, et al.; *VESTNIK LENINGRADSKOGO UNIVERSITETA: BIOLOGIYA*, Vol 24 No 4, Nov 91] 51
- Regional Activities of Enkephalin and Angiotensin-II Forming Peptidases in Rat Brain and Peripheral Tissues in Relation to Ethanol Preference
[O.A. Gomazkov, A.D. Panfilov, et al.; *VOPROSY MEDITSINSKOY KHIMII*, Vol 37 No 4, Jul-Aug 91] 51

Psychology

- Mental Health Statistics in USSR
[N.A. Tvorogova; *ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S.S. KORSAKOVA*, Vol 91 No 11, Nov 91] 52
- Perception of Radiation Health Risk and Health Self-Assessment in Areas With Strict Radiation Monitoring
[V.P. Ferents, V.A. Prilipko, et al.; *ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S.S. KORSAKOVA*, Vol 91 No 11, Nov 91] 52

Radiation Biology

- Clinical Course of Digestive Organs Diseases in Chernobyl Victims
[V.G. Perederiy, N.G. Bychkova, et al.; *VRACHEBNOYE DELO*, No 10, Oct 91] 53
- Lymphocyte Counts, Function and Cytogenetics in Relation to Immunity in Chernobyl Cleanup Personnel
[A.V. Akleyev, M.M. Kosenko; *GEMATOLOGIYA I TRANSFUZIOLOGIYA*, Vol 36 No 8, Aug 91] 53
- Rehabilitation of Myocardial Infarction Patients in Vicinity of Chernobyl Nuclear Power Plant
[I.K. Sledzevskaya, M.G. Ilyash, et al.; *VRACHEBNOYE DELO*, No 7, Jul 92] 53
- Acute Pneumonia and Prolonged Exposure to Chernobyl-Related Low-Dose Ionizing Radiation
[M.Yu. Kolpakov, V.I. Maltsev, et al.; *VRACHEBNOYE DELO*, No 7, Jul 92] 53

| | |
|--|----|
| Analysis of the Results of Revealing Thyroid Diseases in Mass Preventive Examinations of the Population of Bryansk Oblast [I. B. Voronetskiy, G. A. Zubovskiy, et al.; <i>MEDITSINSKAYA RADIOLOGIYA</i> , Vol 37 No 3-4, Mar-Apr 92] | 53 |
| New Domestically Manufactured Digital Angiography Unit [G. A. Onopriyenko, A. I. Morozov, et al.; <i>MEDITSINSKAYA RADIOLOGIYA</i> , Vol 37 No 3-4, Mar-Apr 92] | 54 |
| Use of Low-Intensity Electromagnetic Waves in the Millimeter Band in Medicine [O. V. Betskiy; <i>MEDITSINSKAYA RADIOLOGIYA</i> , Vol 37 No 3-4, Mar-Apr 92] | 54 |
| Analysis of Medical Statistics for the Purpose of Assessing Genetic and Teratogenic Effects of the Accident at the Chernobyl Nuclear Power Plant [N. P. Bochkov, A. Ye. Romanenko.; <i>MEDITSINSKAYA RADIOLOGIYA</i> , Vol 37 No 3-4, Mar-Apr 92] | 55 |

Neurotransmitter Interactions in Specific and Nonspecific CNS Structures in Relation to Locomotor Relaxation and Graded Visceral Stimulation

937C0067A Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 35 No 8, Aug 91 (manuscript received 12 Dec 90) pp 758-761

[Article by A.S. Dmitriyev, acad., BSSR Acad. Sci. (dec), M.Yu. Tayts, T.V. Dudina, T.S. Kandybo and A.I. Yelkina, Institute of Physiology, Belorussian SSR Academy of Sciences; UDC 612.8+612.8.015]

[Abstract] Neurotransmitter balance in various brain structures was related to simulated space sickness in 280-320 gram guinea pigs subjected to "dry immersion" for locomotor relaxation and/or stimulation of peristalsis. The results revealed that after two hours of dry immersion choline uptake was increased only in the fastigial nucleus

despite activation of inhibitory noradrenergic and glycinergic processes. In addition, a twofold increase in corticosterone binding to hypothalamic receptors reflected inhibition of the hypothalamic-pituitary-adrenal axis, as did diminished blood glucocorticoid levels. Visceral stimulation alone induced marked (225-285 percent) activation of inhibitory glycinergic mechanisms in the fastigial nucleus and the parietal cortex. Concomitant twofold activation of noradrenergic mechanisms in these structures further depressed cholinergic mechanisms and was accompanied by serotonin uptake in most brain formations as further evidence of stress. Combination of locomotor relaxation and visceral stimulation yielded results essentially analogous to those seen with visceral stimulation alone, with noradrenergic mechanisms predominating only in the lateral vestibular nuclei. These findings indicate that the visceral component in space sickness is largely mediated via the fastigial nucleus. Figures 1; references 12: 1 Belorussian, 11 Russian.

Effect of Terminal Modification of Oligonucleotides on Their Stability in Mycoplasma Cells

927C0511A Kiev *BIOPOLIMERY I KLETKA*
in Russian Vol 7 No 5, Sep-Oct 91 (manuscript
received 4 Feb 91), pp 37-41

[Article by V. V. Vlasov, V. F. Zarytova, Ye. M. Ivanova, Yu. D. Krendelev, M. N. Ovander, and A. S. Rayt; Novosibirsk Institute of Bioorganic Chemistry, Siberian Department of the USSR Academy of Sciences; Institute of Molecular Biology and Genetics, Ukrainian SSR Academy of Sciences, Kiev; UDC 577.113.4]

[Abstract] Recently, it has been shown that mycoplasmas play an important role in the development of AIDS in individuals infected with HIV-1. The goal of this work was to study the effect of modifying the 5'- and 3'-terminal groups of deoxyribooligonucleotides on their

stability in culture media and in *Acholeplasma laidlawii* PG-8 and *Mycoplasma carpicum* California Kid mycoplasma cells. It was shown that in a medium with 10 percent horse serum, all derivatives were stable for 24 hours. In a medium with mycoplasmas, as well as inside the cells, all the unprotected oligonucleotides were rapidly degraded at the 5'-terminals to mononucleotides and dephosphorylated. In the cells, the phosphate formed was reutilized. Phenazine or cholesterol groups at the 3'-terminal of the oligonucleotides enhanced their stability. Derivatives of heterogeneous oligonucleotides degraded more rapidly than oligothymidilates. Modifying oligonucleotides at the 5'-terminal by forming 5'-phosphoramides prevented their dephosphorylation and slowed oligonucleotide degradation. The latter, protected at the 3'- and 5'-terminals, were the most stable with respect to mycoplasma nuclease activity. Figures 3; references 12: 6 Russian, 6 Western.

Identification of Reference Strains of *Leishmania major*, *L. turanica*, and *L. gerbilli* Using Polymerase Chain Reaction With Universal Marker

937C0044A Moscow MEDITSINSKAYA
PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI
in Russian No 1, Jan-Feb 92 (manuscript received
2 Aug 91) pp 21-22

[Article by S. A. Bulat, M. V. Strelkova, and V. V. Sysoyev, Nuclear Physics Institute imeni B. P. Konstantinov, Leningrad; Medical Parasitology and Tropical Medicine Institute imeni Ye. I. Martynovskiy, Moscow; UDC 576.893.161.13.082.13]

[Abstract] The objective of this investigation was to determine the possibility of using universal primer 3-2, which consists of 16 nucleotides, for the identification of three species of *Leishmania* by means of a polymerase chain reaction (PCR). The reference strains used were: MRHO/SU/59/Neal P.—*L. major*; MRHO/CN/60/gerbilli—*L. gerbilli*; and MRHO/SU/80/C1 3720 and MRHO/SU/83/KD-051—*L. turanica*. The results showed that each *Leishmania* species is characterized by its own peculiar PCR pattern. The PCR patterns also demonstrated that two of the strains were both *L. turanica*. In conclusion, the data showed that this method is effective. The advantages are that it can be used for researching easily preserved and transported specimens and that identification can be completed quickly. Figures 1; references 7: 3 Russian, 4 Western.

Efficacy of Combined Preparation of *Bacillus sphaericus* and *Bacillus thuringiensis* H-14 Against Blood-Sucking Mosquito Larvae

937C0044B Moscow MEDITSINSKAYA
PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI
in Russian No 1, Jan-Feb 92 (manuscript received
29 Nov 91) pp 23-25

[Article by A. A. Chabanenko, Ye. N. Bogdanova, Yu. V. Yermishev, and V. P. Dremova, Medical Parasitology and Tropical Medicine Institute imeni Ye. I. Martynovskiy, USSR Ministry of Health, Moscow; TsKIL Disinfection Station; GUZM, Moscow; UDC 615.285.7.036]

[Abstract] The objective of this investigation was to determine the nature of the effect of two pathogens, *Bacillus sphaericus* (Bs) (sferolavritsid [sic]) and *Bacillus thuringiensis* (Bt) (baktokulitsid), on *Culex*, *Aedes*, and *Anopheles* mosquito larvae when used in different ratios. It was found that Bs/Bt mixtures in ratios of 95:5 to 83.3:16.7 were most toxic to *Aedes aegypti* mosquitoes. Field tests in open, warm reservoirs and flooded basements with Bs/Bt in a ratio of 83:17 showed that a dose of 1 g/m² killed all *Culex*, *Aedes*, and *Anopheles* larvae within 24 hours. In addition, testing in homes in Karakalpakskaya ASSR revealed that all mosquitoes were dead within 24 hours of treatment in 89 percent of the homes. In conclusion, the results demonstrated that the mixed preparation is more effective against mosquito larvae than sferolavritsid alone. Further testing in larger areas is recommended to more clearly determine the advantages of this treatment. Tables 3; references 6: 3 Russian, 3 Western.

Report on Radiation Conditions in Kazakhstan

937C0098A Alma-Ata BIRLESU in Russian
No 28, 1992 p 7

[Article by Smantay Tleubergenov: "Radiation in Our Country and Elsewhere"]

[Text] Mankind's experience shows that we cannot expect to completely eliminate all consequences of radioactive contamination of the human environment.

The most substantial confirmation of this can be found in the Chernobyl Nuclear Power Plant tragedy. In terms of the scale and possible consequences to the population and the environment together with its ecosystems, the Chernobyl accident is the largest and most serious of the entire history of world use of atomic energy. From the standpoint of the biosphere's radiation safety, Chernobyl was not simply an accident—it was a global catastrophe. A sum total of 14 oblasts and three republics suffered.

But what is the status of radiation contamination in Kazakhstan? Besides the woefully famous Semipalatinsk test area, attention should be turned to biomedical, social, psychological, and economic rehabilitation of the populations of Aktyubinsk, Guryev, Mangistausk, Uralsk, Kustanay, Chimkent and Tselinograd oblasts where nuclear tests were conducted.

The radiation situation in Kazakhstan can be called catastrophic in terms of its long-term consequences, a national disaster that has affected the lives of hundreds of thousands of people residing over an enormous area of the republic.

Rehabilitation work costing 7 billion rubles was carried out just in 1986-1989 in areas affected by Chernobyl's fallout. It would seem that the work has taken off. But expert opinion was more than categorical: The amount of work done, including scientific research, cannot be thought of as adequate. The experience of the radiation accidents at Chelyabinsk in 1957 and at the Three Mile Island Nuclear Power Plant in the United States in 1979 shows that it hardly makes any sense to talk about completely eliminating all the consequences of radiation disasters. A number of areas that had been subjected to radioactive contamination in the southern Urals more than 30 years ago are still closed off, having been removed completely from economic turnover: The area in the vicinity of Harrisburg, where the Three Mile Island Nuclear Power Plant is located, was declared closed to economic use for a minimum of 100 years.

So what does that say for our regions of radiation, where practically nothing is being done and which have not been alienated from economic use? Here's a specific example. Air, ground, and underground tests of various types of missiles and military equipment have been going on for a long period of time over a significant area of Western Kazakhstan. Fragments of these lethal projectiles often fall from the sky, cluttering the fields and encumbering agricultural operations; the combustion products of propulsion units—toxic chemicals—also fall out and contaminate the water and soil.

Hence follows the objective difficulty of obtaining "clean" agricultural products from land subjected to chemical and, all the more so, radioactive contamination. The highly complex problem of radionuclide migration through the landscape will have to be solved, and practical workers will need substantiated prognoses. Otherwise costly measures in agriculture and the selection of a general strategy for human habitation of contaminated territories will be carried out without justification. There are apprehensions that land removed from economic turnover could become a seedbed of zoonotic infectious diseases, and besides that, of agricultural and forest pests and harmful species of plants and animals.

The closing of the Semipalatinsk nuclear test range is only the beginning of a lot of hard work. All test ranges in Kazakhstan that continue to render the biological environment lifeless must be closed without delay. It was said in Minsk at the All-Union Conference on Problems of Ecological Education (June 1991) that the area occupied by military test ranges in Kazakhstan is comparable to the area of plowed land—20 million hectares.

The intellectual, scientific and technical potential of military test ranges must be channeled into eliminating the consequences of the testing carried out on those territories.

The International Commission on Radiological Protection has a large array of experimental data and epidemiological observations, which say that the carcinogenic risk depends, as does the risk of the genetic effects of irradiation, on injurious environmental factors of chemical and physical nature. When irradiation acts jointly with a number of risk factors, the manifestations of malignant illnesses and mutagenic effects may increase by an order of magnitude (a synergetic effect). In this connection we need to study the ecological situation in sheep raising regions and determine ecologically dangerous objects with the goal of covering them over or rehabilitating them at the first opportunity.

Let's look at the figures to get a better understanding of the situation as it has evolved. Among children from 1-16 years of age in Abayskiy Rayon, Semipalatinsk Oblast, 80 percent have anemia and 30 percent are disabled. These are children of the second and third generations born after the beginning of nuclear testing.

The high morbidity and mortality and worsening of the social living conditions of the local population led to growth of conflicts and public disorder. This says something about the psychological state of the population, which may be characterized as desperate. The awareness that the nation's gene pool is degenerating injects fear in the hearts of the people for the future of their children and for the future of the Kazakh people.

Creating well being for the people should be the main function of the state. In building a sovereign state, it is very important for us not to forget precisely why we wished to rid ourselves of the dictatorship of the center, and what was the primary cause that made us aware of the need for the republic to possess its own sovereignty.

Management begins with goal-setting. Management of public production is organized in order to achieve the goals that are set. But the goals must have a hierarchy (priorities), rather than being a random assortment. Neglect of the real hierarchy of needs, attitudes, and values characterizing the mental state of the population can encourage growth of mistrust in the authorities, and in the aspect of mental health—development of neurotic reactions, growth of anxiety, and increase of the stress background.

In order to have a productive and business-like dialogue with the population in a time of ecological crisis, the authorities must display empathy—the readiness to suffer with the people. This is a prerequisite of the success of measures to provide effective assistance to suffering communities.

Inadequate attention to psychological problems brought on by want and insufficient attention to the individual could produce an uncontrollable social situation in the region and lead to unforeseen social consequences.

We do not have a conception of safe human habitation in areas of radioactive contamination—that is, we do not have a comprehensive approach to solving medical, social, technical, economic, and ecological problems. We need to organize a scientific-technical collective to develop such a conception—a program intended for the long run.

I. Biomedical Rehabilitation

1). We need to establish consultative polyclinics, outpatient and inpatient institutions, and diagnostic and rehabilitation centers.

Japan's experience in establishing an outpatient system for people is fundamentally important. This work was precisely what gave the world community so much knowledge about the effects of radiation. We need to borrow the experience of creating outpatient treatment centers in Hiroshima, and thus avoid the mistakes already made in 45 years by Japanese and American researchers. Capital investments must not be dispersed: They should be directed at gradual establishment of model medical institutions that could immediately begin working at the highest level.

2). We need to screen newborn infants to reveal congenital abnormalities with the purpose of conducting prompt substitution therapy.

3). Children who are especially seriously ill (with leukemia, lymphomas, etc.) should be treated abroad without delay if such treatment is impossible in our country.

4). To the extent possible, natural barriers should be established to geochemical migration of long-lived radionuclides.

5). The methodology of drawing maps of the natural ground and water complexes of all contaminated territories showing ecological, radiological, and geochemical patterns should be developed, and the maps should be drawn. Their scale should permit the planning and organization of

comprehensive measures to eliminate the consequences of nuclear testing and establish an environmental monitoring system.

6). New medical organizational technology should be introduced, to include:

a. screening programs for early detection of socially significant diseases;

b. genetic monitoring;

c. automated assessment of risk factors at the individual level;

d. an automated control system for preventive examination and treatment of the population;

e. automated individual health passports (files).

II. Economic Rehabilitation

1). The first thing that must be done is to organize mass production of personal radioactive monitoring instruments.

2). When it comes to economic rehabilitation, emphasis should not be placed on money compensation today. This mechanism would be inadequate given the swiftness of devaluation. It would be suitable to make central purchases of the complete assortment of clean food products at the level of hygienic standards (instead of money compensation). This includes more fruits and vegetables capable of removing radionuclides from the body.

3). Underground water sources should be developed as the primary means of supplying drinking water in a zone contaminated by radionuclides. In places where underground explosions had not been carried out, 80 percent of the diseases of the population are due to poor water quality.

4). Construction of harmful chemical, biological, and other ecologically dangerous enterprises must be prohibited on land subjected to radioactive contamination.

5). Use of chemical fertilizers in farming must be prohibited.

6). Incorporation of radioactive dirt by construction materials and structures fabricated in contaminated regions must be prevented.

III. Social and Psychological Rehabilitation

Cultural and educational activity plays a great role here. In order to preserve a stable psychological situation, special effort must be applied in regions where the population will continue to reside on contaminated land in the future. In the absence of trust in the printed and spoken word, events cannot develop normally. An unfavorable course of events threatens the destruction of the social and cultural foundations of the state's existence.

1. Knowledge on radiation and its actions upon the body must be disseminated effectively, and cultural work must be conducted in suffering population groups. Resources should be channeled not only into construction of new

social and cultural institutions, but also into retention of old educators and training of new ones, and into education and training of the young.

2. Specialists must be trained in dosimetry, agricultural radiology, and radiation safety.

3. It would be unsuitable to locate educational institutions attracting young people from all over the republic in regions contaminated by radionuclides, and if such institutions are there, they should be relocated.

4. The actions of government departments and individuals guilty of misinforming the population, of concealing information vitally important to the health of hundreds of thousands of people, and of taking too long to make important decisions must be brought under public scrutiny—not with the purpose of filing complaints (this no longer makes sense with the breakup of the USSR), but rather with the goal of subjecting the culprits of such a monstrous, deliberate crime against an entire people to public condemnation. Perhaps the time of spiritual rebirth of the Kazakh people will begin with this process—psychological rehabilitation of the suffering population.

Solving the complex problem of ensuring safe habitation in zones of elevated radiation requires serious scientific support.

It would be suitable to utilize experience accumulated by the international scientific community over the last 30 years to assess the risks and damage of ionizing radiation. In particular, maximum use should be made of experience acquired during the study of the consequences of nuclear bombing of Hiroshima and Nagasaki.

Kazakhstan's territory should be declared open to the broad world scientific community specializing in ecological problems. In such a way we could get a great deal of help from various experts, as well as biological dosimetrists.

There is doubtlessly good reason for uniting efforts in the sphere of radiology with highly qualified specialists of the CIS.

Dolphins To Be Used in EKOBAROS Program To Clear Baltic Mines

*937C0101A St. Petersburg SANKT
PETERBURGSKIYE VEDOMOSTI
in Russian 15 May 92 p 3*

[Text] An operation to locate ammunition containing war gases and to raise it from the bottom of the Baltic Sea is to be conducted within the framework of the EKOBAROS (Ecological Protection of Russian Water Basins) program. Trained common dolphins, white dolphins, and sea lions are being prepared for this work in the military oceanarium in Sevastopol.

Dolphins have been used for military purposes for a long time now. Naturally, the military has simply tried to keep this direction of its work quiet. And now, in a time of universal glasnost, IZVESTIYA journalists Andrey Chepak and Dmitriy Khrupov were able to visit the Sevastopol oceanarium.

"In preparing for operation EKOBAROS, we took our own research and the experience of American colleagues as our guidelines. During the war in Vietnam, as we know, the Americans used dolphins to protect their naval bases, and during combat operations in the Persian Gulf, to clear mines from several regions of the sea," said Captain 1st Rank V. Yurganov, the oceanarium's chief. "Our common and white dolphins and sea lions have not yet been used for military purposes. They have basically been used to study the bottom of the Black Sea and rather successfully, I should say: Several dozen archeological antiquities worth over 10 million rubles have been discovered and raised with the help of our 'graduates'."

Data on Spread of *Culex pipiens* Throughout USSR

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576.895.771:574.3]

[Text] The role of *Culex pipiens* L. mosquitoes, and espe-
cially their autogenic form *Culex pipiens molestus*, as a
widespread and importunate pest of man in cities of the
USSR and other countries has been known for a long time
(1950-1960). Special research performed in 1960-1970 in
different climatic zones of the USSR made it possible to
obtain more details on the aspects of their ecology and
primary reasons for the widespread appearance in cities.
The most typical breeding sites for *Culex pipiens molestus*,
namely continuously or periodically heated basements in
residential buildings, were studied, the reasons for their
formation were identified, and measures for eradicating
them were proposed^{1, 5}. Nevertheless, the mass appearance
of indoor breeding grounds for *C. p. molestus* and the
extensive spread of these mosquitoes throughout the

country are continuing with the ongoing construction of new
cities and city-type villages in both older and newly urban-
ized territories.

However, even at present published data on the spread of *C. p. molestus* throughout the USSR are extremely limited. A. S. Aksenova and Ye. S. Kupriyanova presented the most complete information for 1950- 1978^{1, 5}. They deal with relatively large cities (approximately 40), primarily in the southern oblasts of the European USSR, the Caucasus, Central Asia, and the Far East. In recent years a few reports on the spread of *C. p. pipiens* and *C. p. molestus* in cities in Soviet Georgia^{10, 11}, the European north^{7, 9}, and in some cities of Siberia^{6, 15, 16} have appeared in the press. However, publications on the spread of these mosquitoes in most cities of the European USSR, especially in its eastern and northeastern oblasts, as well as cities in western and eastern Siberia and the Far East are not available.

In order to evaluate the situation that has developed in the country in recent years and map the spread of *C. p. molestus* throughout the country, we used data collected by means of a specially developed survey, which was sent to us by entomologists at the republic, kray, oblast, and municipal sanitation and epidemiology stations, mostly from the RSFSR, but also from some parts of the Ukraine, Kazakhstan, and other republics, as well as data from the annual reports of the sanitation and epidemiology stations for 1989 and 1990, published sources, and our own data. However, for a number of rayons in the country, the

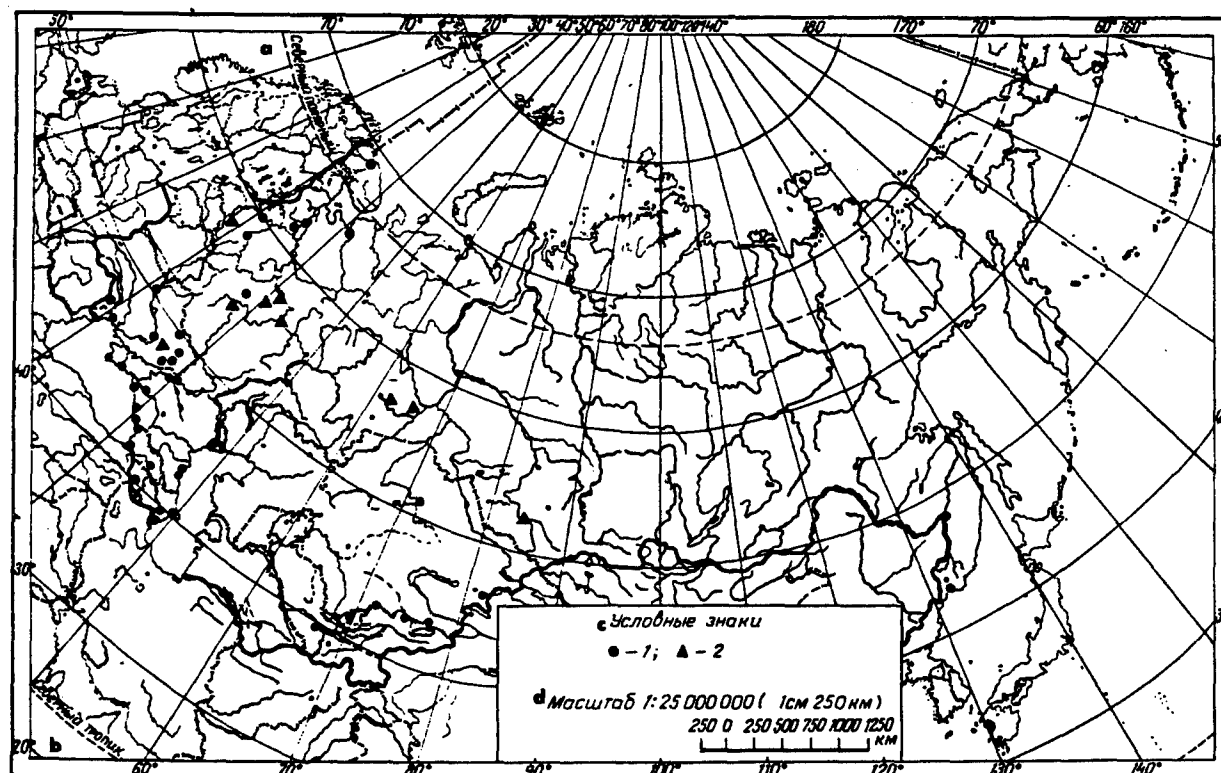


Fig. 1. 1—Cities in which the indoor populations of *C. p. molestus* are high; 2—low.

Key: a. Arctic Circle; b. northern tropic; c. legend; d. scale.

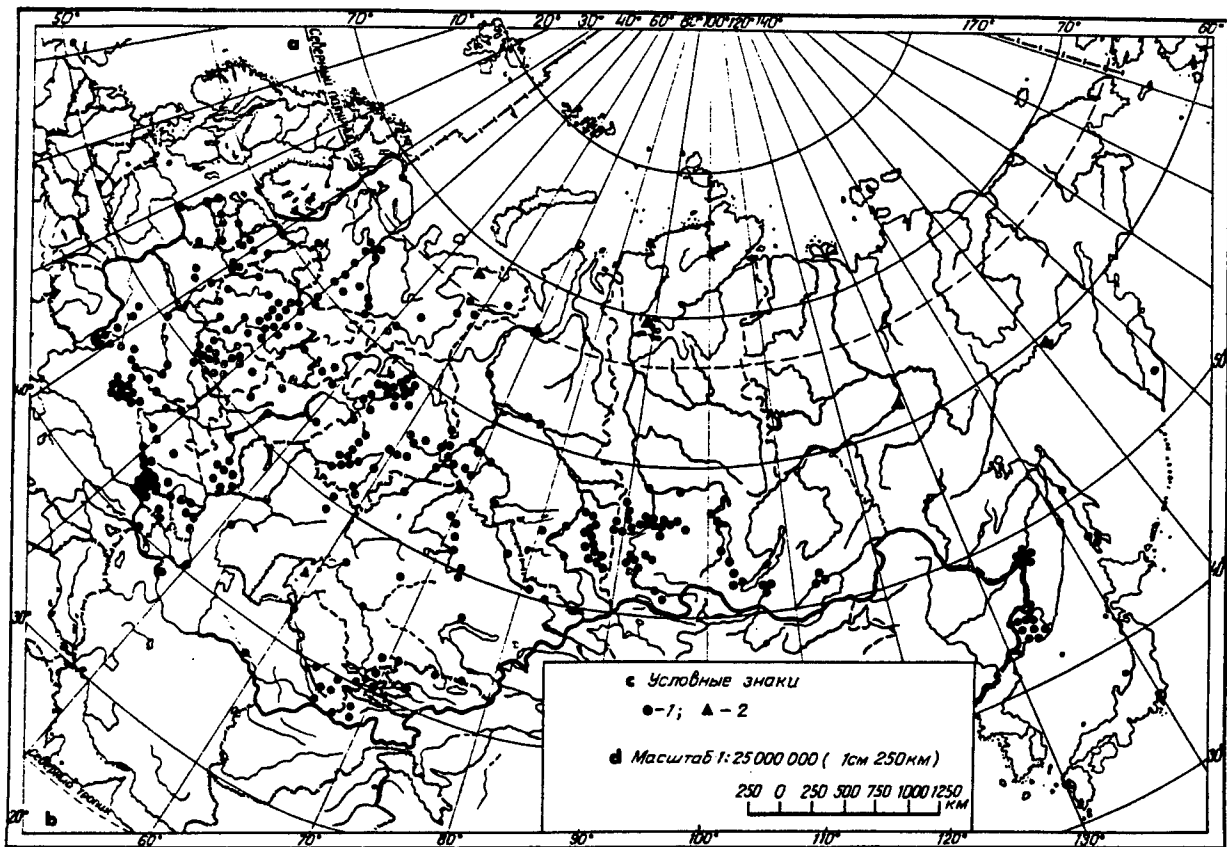


Fig. 1. 1—Cities in which the indoor populations of *C. p. molestus* were found; 2—were not found.
Key: a. Arctic Circle; b. northern tropic; c. legend; d. scale.

information could not be obtained mainly because the entomologists did not have the necessary equipment.

Results

In addition to current data on the geographic range of *C. p. molestus* mosquitoes in the USSR, data we obtained from the sanitation and epidemiology station made it possible to supplement information on their spread for the preceding several decades as well (1950-1978). Thus, it was found that in addition to the cities indicated in Fig. 1, according to the above-mentioned authors, indoor breeding grounds remained in cities in the eight central oblasts of the European USSR and Riga. They were also found in small numbers in the Urals (Sverdlovsk) and in some cities of Tyumen and Kemerov Oblasts, where there was intensive construction of industrial and residential buildings in the 1950s.

An analysis of the data that we collected, in spite of the fact that they are incomplete, shows that indoor populations of *C. p. molestus* have spread extensively over a large area of the USSR over the last decade (Fig. 2). In the center of the European USSR, besides major cities such as Moscow and its environs, Nizhniy Novgorod, Tula, etc., in which large

indoor breeding of *C. p. molestus* was recorded for 1950-1970, these mosquitoes have extensively spread to many other oblast and rayon cities where they were not previously found. In the Western European territory, in addition to Riga, they have been found in small numbers in other cities of Latvia, Lithuania, Estonia, and Kaliningrad Oblast.

The *C. p. molestus* mosquitoes are continuing to spread to the southern rayons of the country. Thus, the number of cities that they have spread to in Zaporozh and Odessa Oblasts and Stavropol Kray has considerably increased. In the Crimea, where they were only found in Feodosiya in the 1960's, indoor breeding is presently noted in all large and small cities and city-type villages. The mass breeding of *C. p. molestus*, and in the summer possibly *C. p. pipiens* in basements of buildings and their mass attack on people occurs in cities and city-type villages on the Black Sea coast in the Caucasus (up to 1,200 m above sea level)¹¹ and in cities on the coasts of the Azov and Caspian Seas, including cities in Kalmykiya, and in other areas.

During the past decade *C. p. molestus* mosquitoes, which had previously only been found in St. Petersburg, Petrozavodsk, Murmansk, and Vologda, that is, in the western and northwestern rayons of the European north, have moved

far into the eastern and northeastern rayons. Thus, for example, in Arkhangelsk Oblast, where in the early 1970's these mosquitoes were found only in Arkhangelsk itself, since 1979-1980 they have been found in other major port cities on the coast of the White Sea and in the northwestern oblasts in the northern taiga subzone.¹ They have also been found in dozens of large and small cities and city-type villages, primarily in the southwest of oblasts in the subzone of the southern and central taiga.

In Komi, where observations have been made since 1960, *C. p. molestus* was first registered in 1983 in the southern part of the oblast, in the subzone of the southern and central taiga, and in the heated basements of Syktyukar and Ukhta. Prior to the early 1980's, only *C. p. pipiens* was found within these subzones. In 1984-1985 *C. p. molestus* gradually penetrated into the cities of the extreme north: the polar Inta (66 degrees 4 minutes north latitude) and Pechor (65 degrees 14 minutes north latitude), and to Vorkuta (67 degrees 2 minutes north latitude), which is above the Arctic Circle^{7, 9}. These cities are located in the permafrost, with a cold, harshly continental climate similar to that of Western Siberia (subzone of the far north taiga). Under the conditions of the cold, short summer of this subzone, the mass year-round development of *C. p. molestus* in the heated basements of apartment buildings and their attack on people in their apartments are possible only when the buildings are not heated for a year (including summer). In natural reservoirs the water temperature in the summer does not rise above 5-7°C.

C. p. molestus has not yet been found in the polar cities of Narya-Mara or Salekharda.

In the early 1980's (1983-1984), the extensive spread of *C. p. molestus* to the industrially developed and heavily populated rayons of the Urals (Vyatsk and Perm Oblasts, Udmurtiya, and Bashkiriya) was recorded. During these years the *C. p. molestus* mosquitoes extensively spread to the heated basements of apartment buildings in cities and villages in the vast territory of the Urals and Western Siberia: to Sverdlovsk, Tyumen, Kemerov, Chelyabinsk, Novosibirsk, Kurgan, and other oblasts, as well as Altay Kray and northern Kazakhstan.

In eastern Siberia, which has most of Krasnoyarsk Kray, Irkutsk, and Chitinsk Oblasts and Buryatiya, small indoor breeding grounds for *C. p. molestus* and the attack of people by these mosquitoes in their homes in the winter were first recorded in the early 1980's in just a few sectors of Krasnoyarsk⁶, Irkutsk, and Chita⁹. Within 2-3 years, in spite of measures taken to eradicate them, the mosquitoes had already spread throughout most of these cities. In the following years (1985-1989) similar breeding grounds for *C. p. molestus* were found in dozens of large and small, old and new cities, and city-type villages in Krasnoyarsk Kray and in many cities in Irkutsk Oblast. During these years only two to three residential areas in Chitinsk Oblast were screened, and these mosquitoes were also found there⁶. Breeding grounds for *C. p. molestus* in some apartment buildings among farm-type structures appeared also in some cities of Buryatiya in 1986 (Ulan-Ude, etc.).

The later appearance of *C. p. molestus* in eastern Siberia in comparison with the times at which they appeared in western Siberia is probably due to its later industrial development, later beginning for mass housing construction, and possibly a less developed railroad network.

In recent years, *C. p. molestus* has been found in Tuva (extreme south of eastern Siberia): in 1986 in Kyzyl and in 1988 in Ak-Dovurak. They are separated from the nearest cities and city-type villages (Abakan, Abaza, etc.) where indoor populations of *C. p. molestus* are numerous, by high mountains and vast uninhabited areas of arid steppes several hundred kilometers wide. They are only connected by air and automobile transport along a few highways.

In Siberia the indoor populations of *C. p. molestus* have spread most extensively in the cities located in its heavily populated central and southern industrial rayons (southern taiga, forest-steppe, and steppe zones, within 52-57 degrees north latitude), with a developed network of railroads and highways. The latter is also typical of the Urals. As the northern rayons of Siberia have become industrialized and industrial and residential construction has unfolded, *C. p. molestus* breeding has also begun here. In western Siberia, the northernmost residential areas in which *C. p. molestus* is currently breeding are as follows: Kondinskaya village (62 degrees 30 minutes north latitude) in Tyumen Oblast (northern taiga subzone); in Krasnoyarsk Kray the northernmost of the cities examined—Lesosibirsk, Yeniseysk, Tayezhnyy (north of subzone of southern taiga, 58 degrees 27 minutes north latitude), and Bratsk of Irkutsk Oblast (subzone of southern taiga, 56 degrees 21 minutes north latitude).

In the cities of Krasnoyarsk Kray above the Arctic Circle: *C. p. molestus* has not been found in Norilsk (69 degrees 21 minutes) or Dudinka (69 degrees 24 minutes north latitude), which are in the eastern Siberian tundra. *C. p. pipiens* is not found in Norilsk, either⁸. The absence of *C. p. molestus* in these cities may be due not only to the severe, extremely continental climate, but also to the aspects of constructing residential and industrial buildings here, in connection with the permafrost soils, on piles, without structural cellars or basements.

C. p. molestus in the Far East was first found in Khabarovsk (1971) and Vladivostok (1965)¹³. At present, in addition to Khabarovsk, these mosquitoes also breed indoors in many other cities and villages of Khabarovsk Kray. In Primorsk Kray, *C. p. molestus* has been found in other cities besides Vladivostok, including the port cities of the southern Pacific coast and the southwestern rayons of the Kray, and in cities and villages located along the Trans-Siberian Railroad, places where they were not previously found. In 1985, breeding grounds of *C. p. molestus*, like other mosquitoes that enter homes, were first found on Sakhalin Island in Aleksandrovsk-Sakhalinsk, which is on the western coast in the center of the island (approximately 51 degrees north latitude, taiga zone). At present, indoor populations of *C. p. molestus* are also found in cities in the southern, southwestern, and southeastern coasts of the island (40 degrees 40 minutes north latitude), and in rayons with a milder climate (coniferous-broad-leaved

forests of the Far East). The southern part of the island also has *C. p. pipiens*¹⁴. *C. p. molestus* has also been found in Petropavlovsk-Kamchatsk, which is on the southern part of the peninsula, where there is no permafrost and the municipal buildings have heated basements.

As follows from the data sent to us from the sanitation and epidemiology stations, the *C. p. molestus* mosquitoes have not been found in the cities of central and southern Yakutiya², which have permafrost and an extremely continental climate and a very warm summer, or in cities of northeastern Siberia, Magadan, or Chukotka, which also have permafrost soils and a cold, severe climate. The absence of *C. p. molestus* in these rayons may be associated with climatic factors as well as the construction of modern buildings, built on piles in these zones. In addition, their considerable distance from other cities that do have them may impede the spread of the mosquitoes.

According to data from the Medical Parasitology and Tropical Medicine Institute imeni Ye. I. Martynovskiy expeditions, the number of cities in Central Asia in recent years in Uzbekistan and Tadzhikistan in whose heated basements there is mass breeding of *C. p. molestus* mosquitoes and *C. p. pipiens* mosquitoes as well in the summer, has considerably increased. The mosquitoes are also attacking people.

Conclusion

Thus, to date indoor populations of *C. p. molestus* have extensively spread throughout old and new cities and city-type villages in most of the European USSR, including its western, northwestern, eastern, and northeastern territory, including arctic cities and those above the Arctic Circle. They have also extensively spread to the Asian territory of the country, particularly to cities and city-type villages in Western and Eastern Siberia, zones with an extremely continental, moderately warm climate, mainly in the southern taiga, forest-steppe, and steppe zones, within 52-57 degrees north latitude. The number of cities inhabited by *C. p. molestus* in Khabarovsk and Primorsk Krays has also increased. They have also been sighted in cities of Sakhalin Oblast and Kamchatka.

In western and particularly eastern Siberia, the northernmost cities in which *C. p. molestus* breeding has been recorded are much further south (62 degrees 30 minutes north latitude), Kondinskiy village in Tyumen Oblast; Lesosibirsk, Yeniseysk, and Boguchany in Krasnoyarsk Kray at 59 degrees 03 minutes north latitude; and Bratsk in Irkutsk Oblast at 56 degrees 21 minutes north latitude) than cities in the European USSR (Murmansk at 68 degrees 58 minutes north latitude, Vorkuta at 67 degrees 27 minutes north latitude, and Arkhangelsk at 64 degrees 32 minutes north latitude). This is likely due to the more severe climate of the northern rayons of Siberia, and their low settlement, population, and urbanization. Moreover, it should be noted that the fauna *Culicidae* that already exist in the northern cities of Siberia have not been adequately studied. For example, they have not been studied in the newly constructed cities on the Baikal-Amursk Highway, in Chukotka, etc.

The northernmost point in the USSR where *C. p. molestus* are currently found¹² is in the western-European tundra (Murmansk). However, this point should probably not be considered the northern boundary of the *C. p. molestus* geographic range, since when the climate is unusually mild for this area; with a comparatively long, cool summer (2-2.5 months) a small population of mosquitoes continues to slowly develop in the basement tanks of apartment houses in the summer, in spite of the fact that the cold season has ended, in water temperatures of approximately 13 degrees C.

The northern boundary of the geographic range reaches into the subzone of the eastern European tundra (far northern taiga, according to the terminology of the author, Vorkuta and Inta, with a severe, cold, extremely continental climate and short, cold summer. The development of *C. p. molestus* in the heated basements of homes throughout the year and their attack of people, including during the summer, is possible here only with year-round heating of the homes⁷, that is under conditions where the existence of these mosquitoes depends completely on man.

The spread of the *C. p. molestus* mosquitoes to cities in the permafrost is presently impeded by the architecture of the buildings, which are built on piles and do not have the structural cellars or basements where these mosquitoes could find breeding grounds.

Man-made transportation, such as the railroad, is the chief means by which *C. p. molestus* spreads throughout a territory, as is true for many other insects. Instances of the appearance of the first breeding grounds in heated basements of the buildings near the stations attest to this⁷. The sequence of spreading to cities located along the railroad lines, which is easily followed when recording their movement to the northern cities, as well as to the east, along the Trans-Siberian Line also attests to this. This is confirmed by published data². The *C. p. molestus* mosquitoes are also transported by water, air, and automobile, to which their appearance in populated areas far from railroad lines attests (cities of Sayanogorsk and Sharypovo, Tuvy, etc.). The significance of the railroad to the spread of *C. p. molestus* is also confirmed by the later settlement of cities in areas with a poorly developed railroad network or when there is no railroad (cities of Sakhalin and Kamchatka).

We would like to express our sincere appreciation to the entomologists of the sanitation and epidemiology stations who sent the data necessary to complete this study.

¹ We present the topographic and climatic characteristics of the vicinity only for the northern and eastern portion of the geographic range for *C. p. molestus* mosquitoes, which has not been discussed in the literature.

² *C. p. pipiens* has not been found in southern or southwestern Yakutiya, either.

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Impact of Socioeconomic and Ecological Conditions on Tick-Borne Encephalitis Morbidity in Inhabited Rayons

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[Article by I. N. Voinov and V. I. Votyakov, Belorussian Epidemiology and Microbiology Scientific Research Institute, Belorussian Ministry of Health, Minsk; UDC 616.831-002-022:578.833.26]:313.13]

[Text] Farm animals can play an important role in the epidemiology of a number of viral infections, such as American equine encephalomyelitis, Western Nile and Rift Valley fevers, Japanese encephalitis, etc., and in the ecology of their etiological agents. Especially noticeable is the role of domesticated animals in regions subjected to intense anthropogenic pressure, where the population density is high, stock breeding is developed, and the number of wild animals, on the other hand, is low. In addition, the technology of raising cattle, its species composition, and the number of head, which change depending on the socioeconomic development of a given region, have a decisive impact. We are attempting to trace such correlations based on the example of tick-borne encephalitis morbidity in Belorussia.

We gathered the following data: data on the morbidity of people with tick-borne encephalitis (per 100,000 persons) in Belorussia from 1947 through 1989 (obtained from the Belorussian Center of Hygiene and Epidemiology); information on the population of cattle and goats in the post-war period (1946-1989) (supplied by the Main Directorate of Animal Products, Belorussia Gosagroprom [State Agricultural Industry]); data on pasture areas (obtained from publications of the "Land Assets of Belorussian SSR" for 1963-1987); data on the numbers of wild ungulates and rabbits in Belorussia (obtained from the Belorussian Department of the Hunting and Fur Farming Scientific Research Institute of Tsentrosoyuz); and the number of *Ixodes ricinus* ticks (calculated on permanent routes using a cultivator or flag in a unit of time per hour).

The second world war inflicted a heavy loss on Belorussia's population and economy. Approximately one-fourth of the people, primarily men, died. It was primarily women and children who remained in the villages, and it was simpler and easier for them to raise hardy goats which needed less food than cows. All of this resulted in the fact that during the post-war years the number of goats drastically increased, peaking at 259,700 head in 1954 (Fig. 1, a). The herds grazed in primitive forest pastures and filled the role not so much of *Ixodes ricinus* tick carriers, the main carrier of tick-borne encephalitis virus, as much as a donor source of the virus for ticks. During these years there was a significant increase in the number of tick-borne encephalitis virus-infected goats². Data in Fig. 1, a, show that during the early 1950's, tick-borne encephalitis morbidity in goats lagged behind their numbers by five to seven years, after which the gap began to rapidly narrow. By the mid-1950's the peak in the goat population lagged behind the peak in morbidity by 2-3 years, that is, by one cycle of development for *Ixodes ricinus*. This may be explained by the fact that during the first post-war years the number of ticks bearing the virus was apparently low, which is indirectly confirmed by the low morbidity of the populace during those years. As the number of goats increased, the goats began to increasingly perform the role of carrier for the ticks, as well as being virus donors. In other words, they facilitated the growth in the tick population and the number of ticks bearing the virus. The goats were first infected by the ticks and then transferred the virus with

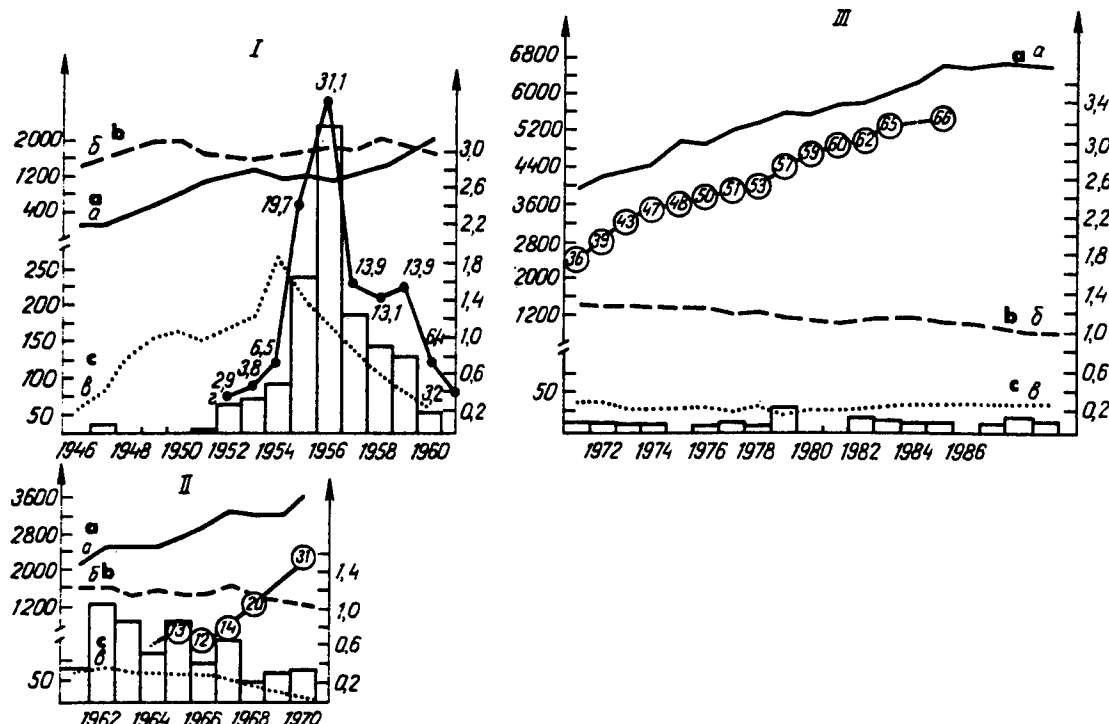


Fig. 1. Tick-borne encephalitis morbidity, goat and cattle population, and percent of cultivated pastures in Belorussia in 1946-1960—I; 1961-1970—II; 1972-1989—III

X-axis represents the years; y-axis represents, from the right, the population of cattle (in thousands), and from the left the morbidity of people with tick-borne encephalitis (per 100,000). a. cattle population in public sector; b. cattle population in private sector; c. goat population; d. goat morbidity (per 100,000). Figures in circles are the area of cultivated and improved pastures (in percent); the columns represent morbidity of people with tick-borne encephalitis (per 100,000).

their blood to uninfected ticks, thus supporting transovarial and transphasic transmission to larvae, nymphs, and in 1-2 years, the imago. This is how the accelerated build-up of the virus-bearing ticks occurred.

Table 1. Dependence of number of actively attacking *Ixodes* on the grazing of cattle in Belovezhskaya Dense Forest (1959)

| Index | Number of actively attacking ticks on routes | | | |
|--------------------|--|--------|-------|-------|
| | larvae | nymphs | imago | total |
| Grazing allowed | 48.0 | 30.8 | 3.6 | 82.4 |
| Grazing prohibited | 2.0 | 17.2 | 1.4 | 21.4 |

As the war-torn economy recovered, the number of cattle began to grow (it grew by $\frac{1}{3}$ during the decade preceding 1958). It was partially due to reparations from Germany and other countries. These cattle apparently were not immune to tick-borne encephalitis virus or acaroantigens since the animals had not come into contact with *Ixodes* prior to importation into the USSR. As our research demonstrated ², at that time in Belorussia cows

were the primary hosts of the imago of *Ixodes* and supported the population growth of the latter due to the large numbers of the former (see Table, Fig. 2). During 1953-1960 the number of cattle increased from 54,000 to 59,000 in Minsk Oblast. At the same time, the average seasonal number of ticks per cow increased from 22 to 43. On the other hand, the activity of the imago following the 1956-1958 surge decreased, which is explained by the depletion of ticks in these phases from nature with cows that graze in forest pastures ². Thus, the considerable number of goats and the increasing herd of cows prompted a rise in the number of virus-bearing ticks in the pastures, the infection rate of goats, and morbidity in people; it peaked in 1956 (3.3 per 100,000). Outbreaks were attributed to the consumption of goat's milk (77.8 percent of cases). After 1954 the number of goats began to sharply decrease, and had dropped by fourfold by the beginning of the 1960's (Fig. 1, b). This prompted a decrease in the number of alimentary cases and total morbidity (to 0.2 per 100,000). Since the beginning of the 1960's, the number of goats stabilized at 65,700 to 30,600, with some trend to decreasing, which supported a continuous, though limited effect of the alimentary means of transmission. At the same time, the

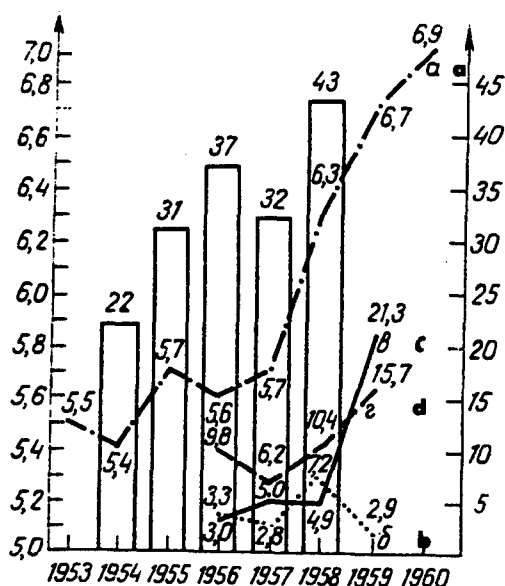


Fig. 2. Comparative representation of cattle population and dynamics of its infection with *Ixodes* and their activity on vegetation in Minsk Oblast for 1953-1960. X-axis represents the years of the average seasonal tick population; y-axis from the left is the cattle population (in hundreds of thousands), from the right is the average seasonal tick population on cattle. The average seasonal indexes of the numbers of active ticks. a. cattle population (in hundreds of thousands); b. imago population in nature; c. nymph population in nature; d. larvae population in nature; columns are the average seasonal tick population for 1954-1958.

number of cows sharply increased. The specific weight of tick-borne encephalitis patients infected transmissively increased. All of this kept total morbidity at a level of 0.3-0.18 per 100,000.

Since the beginning of the 1970's, the number of goats in Belorussia has decreased by 10 percent (in comparison with 1954) and diseases associated with the consumption of goat's milk have been rare.

The number of cows (primary carriers of *Ixodes ricinus* imago) during this time continued to rise and numbered from 3.6 to 6.3 million. In Belorussia at the end of the 1950's, they began to establish improved and cultivated pastures for grazing cattle. The area of pastures grew steadily (at this time it was more than 1/5 of the area of all pastures). Due to these conditions more and more of the tick carriers began to disappear from nature, as a result of which the number of the latter (more than one million) dropped considerably in the early 1970's. Two years later, the morbidity of people decreased by an order of magnitude and since then has virtually been on a sporadic level (less than one case per 100,000). By the end of the 1980's, almost all public cattle were grazing in cultivated pastures or were on a stall diet and ceased to be involved as an

Ixodes carrier, as a result of which the number of ticks in nature decreased even more¹.

At the same time, small outbreaks of an alimentary infection are being recorded as a result of consuming raw goat's or cow's milk. We believe that as a result of isolation from the forest on cultivated pastures and with the stall diet, the calves and cows are not developing immunity to tick-borne encephalitis, as occurred in the past. A non-immune cow that accidentally wandered into a tick-borne encephalitis focus during lactation and was bitten by infected ticks could become a source of the infection, and its milk a factor in transmission to humans.

Elderly people, for whom raising cows on private farms is financially and physically difficult, live in many of the villages in Belorussia that have been decreasing in size over the past decades. Therefore, for milk they raise primarily goats, which do not need a great deal of hay or other feed. In the 1970's and 1980's the number of goats in Belorussia was 20,000-30,000 head. The consumption of goat's milk has frequently resulted in small outbreaks of tick-borne encephalitis (Fig. 1, c).

The number of private cattle grazing in forest pastures remains considerable. There were approximately one million head on January 1, 1989. Even today these animals are the primary carriers of the *Ixodes ricinus* imago. The number of wild animals (rabbits, ungulates, etc.) is several orders of magnitude lower than the number of domestic cattle. According to data from the Belorussian Ministry of Forestry and the Belorussia Department of the Scientific Research Institute of Gaming and Fur Farming of the Tsentrsoyuz, the number of wild ungulates over the past 20 years has not experienced significant changes (the total number of wild boars, roe deer, reindeer, and moose fluctuates from 80,000 to 89,000 head). In connection with reclamation efforts conducted throughout Belorussia, the number of rabbits fell drastically in the early 1970's and in recent years has stabilized on a relatively low level (282,000-323,000). We are not inclined to deny the role of wild animals in the carriage of the pupal phases of *Ixodes* development; however, in the heavily populated rayons of Belorussia, with the development of stock breeding, it is considerably less than the role of domesticated cattle.

Thus, the dependence of tick-borne encephalitis morbidity among Belorussians on the number and specific composition of dairy cow herds and the means of raising them has been demonstrated. Based on knowledge of these laws, we have permitted ourselves, with some degree of caution, to express a view with respect to the trend for the further development of tick-borne encephalitis morbidity in Belorussia in the coming decade. Regression analysis of morbidity, performed together with A. G. Moroz, demonstrated that if the 1980's trends in stock-breeding continue, transmissible morbidity will continue to decrease or remain on the same low level. In addition, we anticipate more frequent group cases of alimentary tick-borne encephalitis (primarily by means of raw cow's milk). The outbreaks will be rare, since the infection of cows will be random. This is confirmed by a computer-calculated line of regression

which assumes the possibility of annual surges in morbidity up to 14 cases per year.

However, it is necessary to bear in mind that the further development of agriculture, especially stock-breeding, by contract, lease, and possibly farms may lead by the end of this century to smaller sizes of some stock-breeding farms. As a result, many contract farms and farming industries, at least at first, may begin to graze cattle on the forest pastures. If there are enough animals on such farms the number of ticks may rise. In addition, we should anticipate a rise in the number of dairy cattle also grazing in forests.

All of this will unavoidably entail an increase in tick-borne encephalitis foci activity and an increase in the morbidity of people with a transmissible means of transmission.

The advent of alimentary family group outbreaks associated with the use of raw goat's milk is also possible. In connection with the general shortage of consumer goods, the demand for goat down and wool may rise. In order to satisfy this demand, rural dwellers will again need to breed goats, which will unavoidably involve the use of goat's milk in the diet.

Thus, our developments will persistently pose the problem of regulating the raising of cattle in Belorussia. It is not only an agricultural and veterinary problem, but also a medical one for regions lying within the tick-borne encephalitis virus geographical range. The natural environment of these inhabited regions is also subject to heavy anthropogenic pressure. It is now necessary to prohibit the grazing of cattle on forest pastures in these regions. We need to create the economic conditions so that government and private farms will be able to profitably graze their animals on cultivated pastures or provide them with stall feed.

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Ecology of *Echinococcus multilocularis* (Leuckart, 1863) and *E. granulosus* (Batsch, 1786) on Kamchatka Peninsula

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[Text] In spite of the seriousness of the problem of echinococcoses on the Kamchatka Peninsula, the biology and ecology of these etiological agents have not been adequately studied. Almost all of the research conducted to date on these helminthiases has been in the biomedical field^{1, 5, 6, 8-11, 13-20}, with the exception of some works that focus on the faunal aspect^{5, 7}.

From 1980 through 1990 at the Kamchatka Department of the VNIIOZ imeni Professor B. M. Zhitkov and the Department of Natural Use, Pacific Ocean Geography Institute, Far East Division, USSR Academy of Sciences, 177 foxes, 4 wolves, 4 lynxes, 116 squirrels, 180 muskrats, 1 Eversman's souslik, 4 Canadian beavers, 183 northern red-backed voles, 128 tundra voles, 45 large-toothed red-backed voles, 3 wood lemmings, and 41 zemleroyka-burozubka (shrew) (species not established) were examined by means of incomplete helminth autopsies.

Natural climatic complexes of the western and eastern coasts, the center, and the north are marked on the peninsula by the regional characteristics of the relief, climate, and the plant and animal worlds. The geography of the helminth fauna to a large degree is determined by the natural-climatic characteristics of these complexes.

Historically, the natural foci of echinococcoses on Kamchatka and the biology and ecology of their etiological agents have experienced considerable changes since the beginning of the century due to natural and artificial enrichment with fauna. By 1950-1960 squirrels, western chipmunks, and lynxes appeared on the peninsula, having independently arrived from the continental area of the oblast¹². According to data from the Kamchatka Department of the VNIIOZ, muskrats were imported from Primorsk Kray in 1959, and Canadian beaver from Leningrad Oblast and moose from the continental area of Kamchatka Oblast (Penzhinskiy Rayon) were brought here in 1977. During the past three decades the process of the anthropogenic effect has accelerated, due to the almost twofold increase in the population and the expansion of the sphere of natural use.

The acclimatized species have become part of the parasitic systems of *E. multilocularis* and *E. granulosus*, which could not help but affect the magnitude and pathways of movement of the infestation origin into parasitic systems. Occasional research on this matter performed at the beginning of the century did not make possible comparative quantitative comparisons of these indexes⁴.

Wolves, domesticated dogs, and foxes have been noted as the definitive hosts of *E. multilocularis*^{1, 10, 11, 18, 20}. Of the four wolves we examined, pubertal *E. multilocularis* was found in one (along with *E. granulosus*) that numbered several thousand strobilae. There are more than 100-150 wolves on the peninsula, therefore, in spite of the high rate of infection of some animals, their epizootologic role is not great. Due to aspects of ecology and eating³ (most of the predators follow the herds of domesticated reindeer, which have displaced the wild ones everywhere), the wolf facilitates the transformation of natural foci of infestation into synanthropic ones.

The number of domesticated dogs that may be involved in the formation of foci of multiloculate echinococcosis, according to our data, is 3,000-5,000. Their invasiveness into rural residential areas is 2.7 ± 1.89 percent according to ¹⁹ and 75 percent according to ⁸. This species attracts considerable numbers of the pubertal segment of the *E. multilocularis* population and serves as the main reservoir of infection material and its supplier from natural foci into synanthropic ones, and vice versa. Due to the dogs, there is continuous circulation and concentration of the etiological agents in human villages. The strength of circulation of the

E. multilocularis infection in synanthropic foci is determined by the aspects of human economic activity (including the raising and use of dogs).

The number of foxes on the peninsula (according to forecasts of the Kamchatka Department of VNIIOZ) fluctuates within several thousand. The average multi-year index of the extent of its infection with *E. multilocularis* was 13.6 percent, according to our data. More animals on the west coast were infected, which agrees with published data ^{13, 15}; fewer animals were infected on the east coast and north (see Table 1).

Infection Rate of Foxes with *E. multilocularis* for Regions in Kamchatskiy Peninsula (1980-1990).

| Year | Western coast | | Central area | | Eastern coast | | Peninsula as a whole | |
|-----------|---------------|----------|--------------|----------|---------------|----------|----------------------|----------|
| | examined | infected | examined | infected | examined | infected | examined | infected |
| 1980-1981 | 20 | 4 | — | — | 3 | — | 23 | 4 |
| 1981-1982 | 1 | 1 | 7 | 3 | 2 | — | 10 | 4 |
| 1982-1983 | — | — | — | — | — | — | — | — |
| 1983-1984 | 6 | 1 | 3 | — | — | — | 9 | 1 |
| 1984-1985 | — | — | — | — | — | — | — | — |
| 1985-1986 | 22 | — | 2 | — | 7 | — | 31 | — |
| 1986-1987 | 21 | — | 10 | — | 2 | — | 33 | 1 |
| 1987-1988 | 15 | 1 | 1 | — | 7 | — | 23 | 1 |
| 1988-1989 | 2 | — | 8 | 3 | 14 | 2 | 24 | 5 |
| 1989-1990 | 17 | 6 | 7 | 3 | — | — | 24 | 10 |
| Total... | 104 | 13 | 38 | 9 | 35 | 2 | 177 | 26 |

The high indexes of the extent and intensity of infection of foxes with *E. multilocularis* and their great number in comparison with other hosts of the parasite make it the primary carrier of the pubertal population of the parasite. Population dynamics, aspects of ecology, the strength of the circulation of the invasion, and the condition of natural foci of this helminthozoonosis in its natural environment are governed by the population characteristics of the foxes themselves. During the 1980-1990 observation period, we noted a coincidence in the rises in the predator population and its infection with *E. multilocularis* twice (in 1980-1982 and 1988-1990). The extent of infection during these periods increased in comparison with average multi-year indexes by 2-2.5 times and were 21.1 and 31.6 percent; moreover, the unprecedented high populations of foxes in 1989-1990 coincided with the same considerable rise in infection.

The intermediate hosts of *E. multilocularis* have been listed as follows: three species of voles—red-backed, large-toothed red-backed, and tundra ^{7, 18, 13-15}, muskrat ¹⁸, and Siberian lemming ¹⁶. Infections of other rodents and insectivores in question has not been noted by us or in published literature. Historically, the natural foci of multiloculate echinococcosis have been determined by the population dynamics of the final and intermediate hosts, among which the red-backed vole is most significant (due to its large numbers and frequency of infection with these helminths). Next are the tundra vole, the large-toothed red-backed vole, and to a lesser degree lemmings, whose

number on the peninsula is considerably lower. The infection rate of the red-backed vole is, according to different authors, 1.8, 0.14 percent ^{13, 19}, and 1.5 percent (according to our data); the tundra vole, 2.79 percent ¹⁵ and 0.8 percent (our data). Of the three Siberian lemmings examined by T. A. Yakovleva ¹⁹, one was infected, but the three that we examined were not. Rises and falls in the fox population on the peninsula are coupled with similar processes in the vole populations, which comprise 43.7 percent of all components of predator food ².

After the muskrat became acclimatized in 1959 and its population covered 60 percent of the peninsula by the end of the 1970's, the natural foci of multiloculate echinococcosis significantly changed qualitatively and quantitatively. The muskrat began to be found in 46-66 percent of all leftover food specimens from foxes in places they jointly inhabited ¹⁷. The infection indexes obtained by different authors confirm the great significance of the muskrat as an intermediate host: 30.45 percent ⁵, 14 percent ¹⁷, 26 percent ⁷, and 7.7 percent (our data).

Hunting for and the use of muskrats for economic purposes began on the east coast in 1968 and on the west coast in 1978. These years may also be considered the times when muskrats became part of the process of transforming the existing natural foci into natural-synanthropic foci. The hunting grounds which were located near the residential areas and were easily accessible were most intensively developed. The hunting process prevents overpopulation

and sapping of the rodent food base. The infection rate among muskrats after the previously undeveloped hunting grounds were opened to industry dropped from 26 percent (1976) to 2.6 percent (1979)⁷. In comparing the extent of the infection rate of foxes with *E. multilocularis* and data on the procurement of muskrats for 1980-1990 in 1982 and 1989 we noted a simultaneous rise in these indexes. During industry, the muskrat carcasses are fed to the dogs, which transforms the natural foci into natural-synanthropic ones and creates new ones due to the dissemination of the infection origin by the dogs when the hunters are hunting animals in other rayons.

The existence of the *E. granulosus* population on the peninsula is determined by two species of final hosts, wolves and domestic dogs^{13, 14, 16}. The species status of the wolf and its biology and ecology on the Kamchatka Peninsula need special study³. Approximately 500 echinococci were found in one of the wolves we examined. The small number of studies does not make it possible to determine the index of the extent of this infection in the predator. Natural echinococcus foci, which exist due to the wolf and wild reindeer, have been transformed by man with the development of reindeer breeding (widespread) into natural synanthropic foci. The number of domesticated reindeer over the past decades has reached 160,000-180,000, while the wild ones are being driven into the areas that are difficult to reach and lack food. Their number (according to data from the Kamchatka Department of VNIIOZ) is less than 4,000-5,000.

The *E. granulosus* infection rate in dogs in rural populated areas is 1.3+/-1.42 percent¹⁹. This index varies by region and year. In one of the areas where reindeer breeding is developed, L. I. Sinovich (1973) found pubertal *E. granulosus* in 6.6 percent of dogs¹⁹.

The high indexes of domesticated reindeer population and their high rate of infection with hydatid echinococcosis are 23.5 percent¹³, 1.25+/- 0.55 percent¹⁹, 25 percent¹⁴, and 0.09-0.78 percent¹⁸, and determine their primarily synanthropic character. Natural foci are insignificant and limited to small sections of the habitat of wild reindeer in the southeast in the center section and north of the peninsula. Due to the economic use of wild reindeer and their contacts with domesticated reindeer in pastures, the transformation of natural foci into natural-synanthropic ones is possible.

In addition to the wild and domesticated reindeer, the acclimatized moose, which numbered at least 500 in 1989, is an intermediate host (data from Kamchatka Department of the VNIIOZ). The industry of this species is not yet established, and its role in the circulation of *E. granulosus* is not yet known. There have been oral reports from the main hunting grounds in Penzhinskiy Rayon, from which the moose were imported, stating that echinococcus vesicles had been found in the lungs of animals killed there. The moose, apparently susceptible to this infection, has become involved in the circulation of *E. granulosus* and areas in which it has become acclimatized (Kamchatka River valley, center of the peninsula) it will facilitate the

transformation of the natural foci there into mixed foci with the opening of industry.

The possibility of the involvement of species such as the lynx (which numbers up to 200, according to data from the Kamchatka Department of the VNIIOZ), the snow ram, the acclimatized Canadian beaver, and representatives of the rodent and insectivore family that inhabit the Kamchatka Peninsula on the function of echinococcus foci needs clarification.

Conclusions

1. The effect of man on the echinococcus habitat and hosts will result in the transformation of natural foci of echinococcoses into natural-synanthropic and synanthropic foci and the formation of new ones on the Kamchatka Peninsula.
2. The epidemiological situation with respect to echinococcoses should be forecasted based on complex monitoring of the condition of the populations of their intermediate and final hosts with mandatory calculation of the infection of domesticated species of animals involved in the circulation of the etiological agent.

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Possibility of Opisthorchiasis Focus Formation in Lower Reaches of Angara

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[Article by O. P. Zelya and I. V. Gerasimov, Medical Parasitology and Tropical Medicine Institute imeni Ye. I. Martynovskiy, USSR Ministry of Health, Moscow; UDC 616.995.122.21-036.21-078]

[Text] The present epidemiologic situation with respect to opisthorchiasis in the Ob-Irtysh, Kamskoye, and Dnieper basins and in Kazakhstan has become evident to a significant degree as a result of numerous studies of the problem. There are much fewer data on the eastern portion of the *Opisthorchis felineus* geographical range. Local cases of opisthorchiasis in Yeniseysk Rayon (Krasnoyarsk Kray)

were identified for the first time⁴. Subsequently, foci of this invasion were found on the Biryusa River and its tributaries (Irkutsk Oblast and Krasnoyarsk Kray)^{5, 6}. Screening of persons in the villages along the lower current of the Angara River revealed a 4.5 percent opisthorchiasis infection rate, and 64 percent of these cases (according to epidemiological anamnesis data) were local infections⁸. The objective of this investigation was to evaluate the biological and hydrobiological factors that made possible the formation of an opisthorchiasis focus in the lower reaches of the Angara River and to predict the change in the epidemiological situation in the area of the proposed construction of the Central Yeniseysk Reservoir.

Material and Methods

The research was performed in July-August 1988 in Motynginskiy Rayon, Krasnoyarsk Kray. The flood plains of the Angara River (like most rivers in this region) are poorly developed. Virtually the only possible habitat for the intermediate host of opisthorchiasis is the branches of the Angara River and reservoirs on the numerous islands located in the Angara River between Motyngino village and the mouth of the Taseyeva River. Twenty-two reservoirs were examined. A compressor method with examination of musculature and subcutaneous adipose tissue preparations under a microscope was employed to examine 44 Siberian dace (*Leuciscus leuciscus baicalensis*).

Results and Discussion

Reservoirs which were a suitable habitat for mollusks, the intermediate hosts of opisthorchiasis, were found only in Motynginskiy Rayon, where the river bed is considerably wider (6-8 km) and is broken up into many islands on a number of branches of the river. These reservoirs are basically inlets 20-1000 m long and 10-30 m wide, which connect to the main river bed. The shores of the reservoirs are silty, overgrown with sedge (*Carex*) and horsetail (*Equisetum*). Pondweed (*Potamogeton*) and *Elodea* dominate among the submerged plant life. Individual specimens of *Boreoelona contortrix* free of trematode larvae were found in two reservoirs. This species of mollusk has not been listed as an intermediate host for opisthorchiasis, but its possible role in the circulation of this helminth cannot be ruled out. *Codiella (Bithynia) inflata* mollusks, which inhabit the flood plain reservoirs of the Biryusa⁷ and consequently inhabit eastern Siberia, could not be found.

Thus, the people living near the lower reaches of the Angara River apparently become infected with opisthorchiasis as a result of consuming contaminated fish that migrate to this rayon from reservoirs located in the breeding grounds of the etiologic agent, especially the Biryusa breeding grounds. Of the other possible opisthorchiasis hosts, dace have the greatest specific weight in traps, while *Leuciscus idus* are rarely found in the right-bank tributaries of the Yenisey⁹. The large scale harvesting and preparation of dace occurs in the fall, when they migrate to Yenisey for the winter. Over the entire summer the dace feed in the tributaries of the Yenisey River and secondary and tertiary tributaries, some of

which may be contaminated with opisthorchiasis metacercaria. Our summertime examination of 44 dace (average size 16.2 \pm 0.4 cm) trapped in the Angara River below the Motygino stretch of water revealed that they were free of *O. felineus*. *Rhipidocotyle campanula* metacercaria infected 52.3 \pm 7.5 percent of the dace. Accordingly, it follows that the existence of an independent opisthorchiasis focus in the lower reaches of the Angara River (Motygino village rayon) is doubtful.

At the same time, it is necessary to note that in connection with the creation of a cascade of reservoirs, the hydrobiological situation in the Angara River has changed. This is reflected in the increase in the concentration of biogenic elements and a decrease in water clarity. The cooling effect of the Baikal waters has also decreased considerably. In addition, we see the "cascade effect", that is, an increase in the trophic level of each newly forming reservoir downstream along the river ^{1, 3}. Accordingly, the river fauna is also changing. Thus, the *B. contortrix* mollusks that we found were not noted in a detailed report of fauna in the lower reaches of the Angara River prior to regulated discharge of the river ². The possibility that they were brought here by waterfowl and *C. (B.) inflata* mollusks has not been ruled out ¹⁰. Thus, when the source of the invasion is present, a significant change in the hydrobiological situation, which is attributed to the construction of a cascade of reservoirs in the Angara River, may facilitate the spread of the geographic range of *O. felineus* in eastern Siberia.

In the case of the construction of the Central Yeniseysk Hydroelectric Power Station and the construction of a reservoir, the Motyginsk Rayon stretch of water will be heated and conditions that favor the existence of mollusks, the intermediate hosts of the opisthorchiasis etiological agent will not be present. However, the situation with respect to the other host (dace) remains as before, as does the risk of people becoming infected with opisthorchiasis.

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Decrease in Humoral Immunity to Tick-Borne Encephalitis Virus in Western Urals Population

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[Abstract] This communication presents the results of repeat serological screenings of a healthy Western Urals population in five geographical subzones (central, mountain and southern taigas, broad-leaved-coniferous forests, and forest-steppe). Conventional methods were used to screen 2,977 persons in 1966-1968 and 1,307 persons in 1988-1989. Observations for the 1966-1968 epidemic seasons indicated that the immune segment of the population varied by geographic subzone, with persons in the broad-leaved-coniferous forests having the highest indexes and those in the central taiga having the lowest. Repeat screenings 20 years later revealed the greatest decrease in the percentage of people with anti-hemagglutinins in the blood sera in the broad-leaved-coniferous forest. These data indicate that changes in the immunologic structure of the public to tick-borne encephalitis virus reflect the dynamics of epidemic activity of natural foci in different subzones of the Western Urals. In conclusion, it is suggested that the main reason for the decrease in the level and strength of humoral collective immunity to tick-borne encephalitis virus is the decrease in the activity of natural foci. Tables 2; references 14: Russian.

Search for Novel Anti-Parasite Agents. 10. Synthesis and Toxicologic and Anti-Malarial Properties of Some Nitrogen-Containing Heterocycles With 4-(4-Alkylpiperazinyl-1) Phenylamine Substituent (Quinoprazine)

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PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI
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[Article by F. S. Mikhaylitsyn, N. P. Kozyreva, S. A. Rabinovich, Ye. V. Maksakovskaya, I. M. Kulikovskaya, N. R. Dadashova, M. N. Lebedeva, A. F. Bekhli, N. D. Lychko, and N. A. Uvarova, Medical Parasitology and Tropical Medicine Institute imeni Ye. I. Martynovskiy, USSR Ministry of Health, Moscow; UDC 615.283.926.012.1.07]

[Abstract] This paper discusses the synthesis and results of toxicologic and chemotherapy research of novel derivatives of quinoline and benzo(g)quinoline containing a 4-(4-alkylpiperazinyl-1) phenylamine substituent with respect to their efficacy against malaria. The anti-malarial activity was tested in mongrel mice (12-18 g) infected with *Plasmodium berghei*. It was shown that the rodents tolerated the agents well. The benzo(g)quinoline derivatives were very effective against malaria and were better than chloroquine with respect to tolerance and protective action. Quinoprazine, the most efficacious of the novel agents tested, was also found to be effective against chloroquine-resistant infections. In conclusion, quinoprazine has been demonstrated to show promise as an anti-malarial agent in rodents. Figures 4; tables 2; references 23: 17 Russian, 6 Western.

Epidemic Manifestation of Natural Foci of Tick-Borne Encephalitis in the Maritime Kray. Report 2. Spatial Differences of the Seasonality of Tick-Borne Encephalitis

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[Article by G. N. Leonova, Ye. E. Borisovets, Scientific Research Institute of Epidemiology and Microbiology, Siberian Department, USSR Academy of Medical Sciences; Pacific Ocean Institute of Geography, Far Eastern Department, USSR Academy of Sciences, Vladivostok; UDC 616.831-002-022.7:578.833.26]-022.39- 036.21]

[Text] Report 1 demonstrated the possibility of the use of computer cartography for estimating the epidemic hazard of focal areas of the Maritime Kray.⁸ That, however, does not exhaust the possibilities of the technique.

Knowledge of the dynamics of morbidity is important.¹⁷ In the very first years of study of tick-borne encephalitis (TBE), a spring-summer seasonality of morbidity was identified, with the maximum number of infected individuals coming in May-June.⁵ "The seasonality of tick-borne encephalitis, its periodicity, and the typical focus associated with the remote, sparsely populated taiga are explained by the features of the biology, ecology, and geographical range of the tick-vectors, whose ability to transmit the encephalitis virus is controlled by environmental factors."⁹ The seasonal variation in the morbidity associated with TBE in any focal area has been depicted graphically, as a rule, in the form of a curve of the change in the number of cases of the illness from April through August-September.

G. P. Stepanov¹⁴ attaches great significance to the mortality rate in certain infections that are, obviously, highly lethal. He feels that the mortality rate is a more accurate indicator of the epidemic process because it depends on the quality of clinical diagnostics and patient record-keeping less than anything else, and pathological-anatomical diagnostics and records of fatal outcomes are, on the whole, more accurate and reliable. Among such

infections in the Maritime Kray one can include TBE, the lethality of which averages 20-25 percent and is as high as 36 percent in some years.⁷

In this report, we have made an attempt to depict, with computer maps, the seasonality not only of the morbidity associated with TBE, but also of its mortality rate, and to use those maps to identify the spatial differences in the epidemic process associated with TBE in the focal areas of the Maritime Kray.

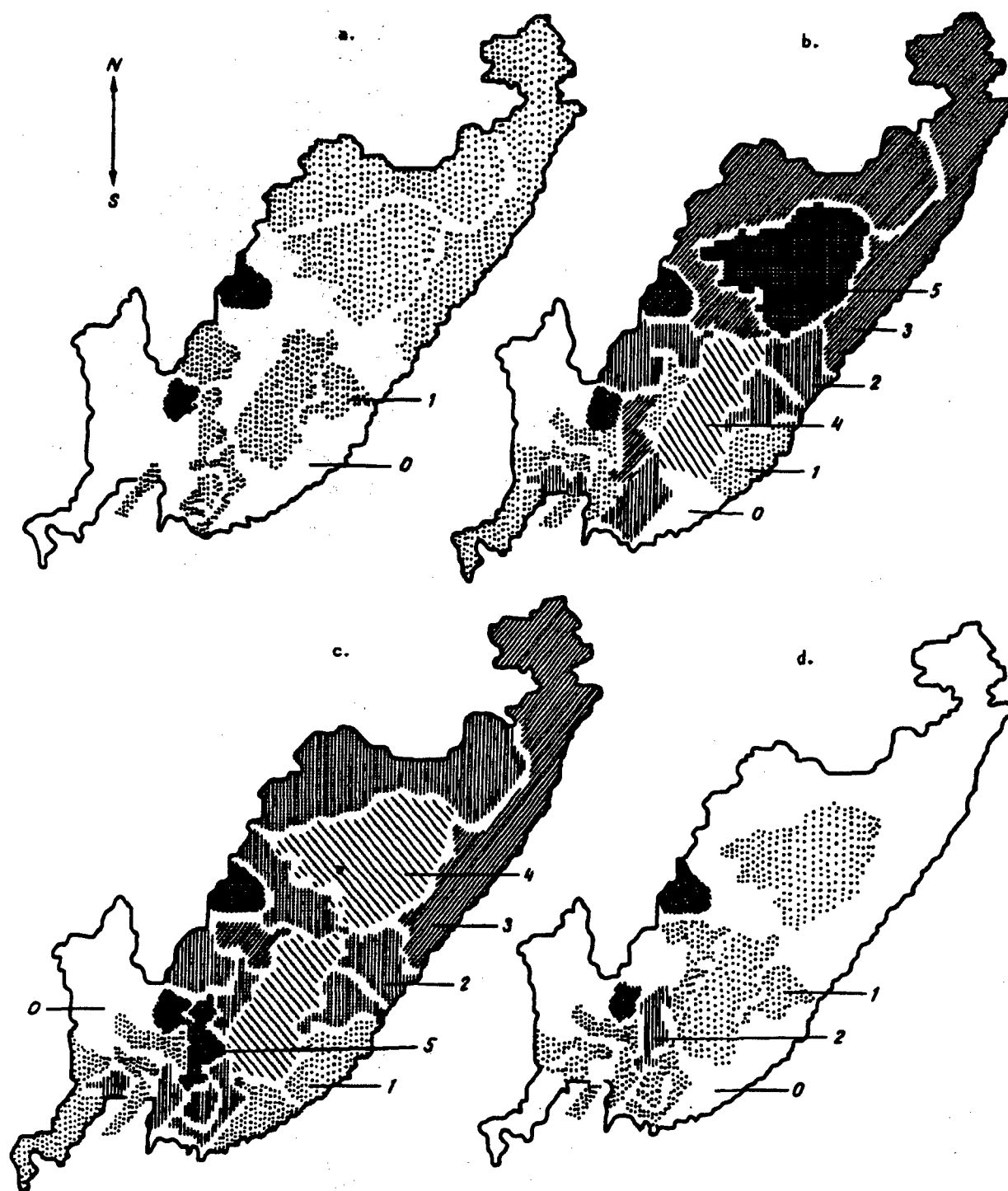
Materials and Methods. In the work reported here, we used the materials and methods described in detail in report 1.⁸

Results and Discussion. With the computer maps of the TBE morbidity (Fig. 1, a-d) and TBE mortality (Fig. 2, a-d), one can graphically trace the variation in the epidemic process from April through September in the focal area of the region of Sikhote-Alin. Cases of the illness (Fig. 1, a) and fatal outcomes (Fig. 2, a) appeared in April in the northern rayons of the kray. In May, the epidemic process encompasses virtually the entire kray. In the mountain regions of Sikhote-Alin, that process reaches an average level of intensity in the period indicated. With an extremely low level of morbidity in the southern and coastal areas of the kray, there were virtually no deaths in April and May (see Fig. 2, a). June and July were characterized by the highest morbidity and mortality indices. The highest figures for morbidity (Fig. 1, b, 5) and mortality (Fig. 2, b, 5) in June are noted in the northern rayons of the kray; in July (Figs. 1, c, 5 and 2, c, 5), in the southern offshoots of Sikhote-Alin. In August, the figures for morbidity and especially mortality in the northern rayons of the kray either decline or drop to virtually zero. In September, morbidity (Fig. 1, d, 2) and especially mortality (Fig. 2, d, 1) remain at a low level in only the southern offshoots of Sikhote-Alin and the southern coastal zone of the kray.

Using the data of morbidity and especially mortality reflected in figures 1 and 2, one can arbitrarily divide the Maritime Kray into two parts: the northern part, with the most active epidemic process in the rayon located on the central-eastern slope of the Sikhote-Alin ridge; and the southern part, with a center on the southeastern slope of that ridge. Those two areas are separated by the watershed of the largest river in the kray, the Ussuri.

In the first area, the epidemic season lasts primarily from April through August, with the highest TBE morbidity in June (see Fig. 1, b). In the southern area, the epidemic process covers the period from April-May through September, with a morbidity peak in July (see Fig. 1, c). Those differences in the seasonal dynamics of the epidemic process in the two areas can be tracked more clearly with computer maps of TBE mortality (Fig. 2, a-d). For example, in the northern rayons, TBE mortality is observed from April through July, with a maximum in June; in the southern area, from April through September, with a maximum in July.

The figures for the average lethality for the entire kray tend to decline from April through May and rise gradually from June through September.



a,b,c,d represent the morbidity in April, June, July, and September, respectively.

0: absence of morbidity

1: 0.02-5.99 per 100,000 population

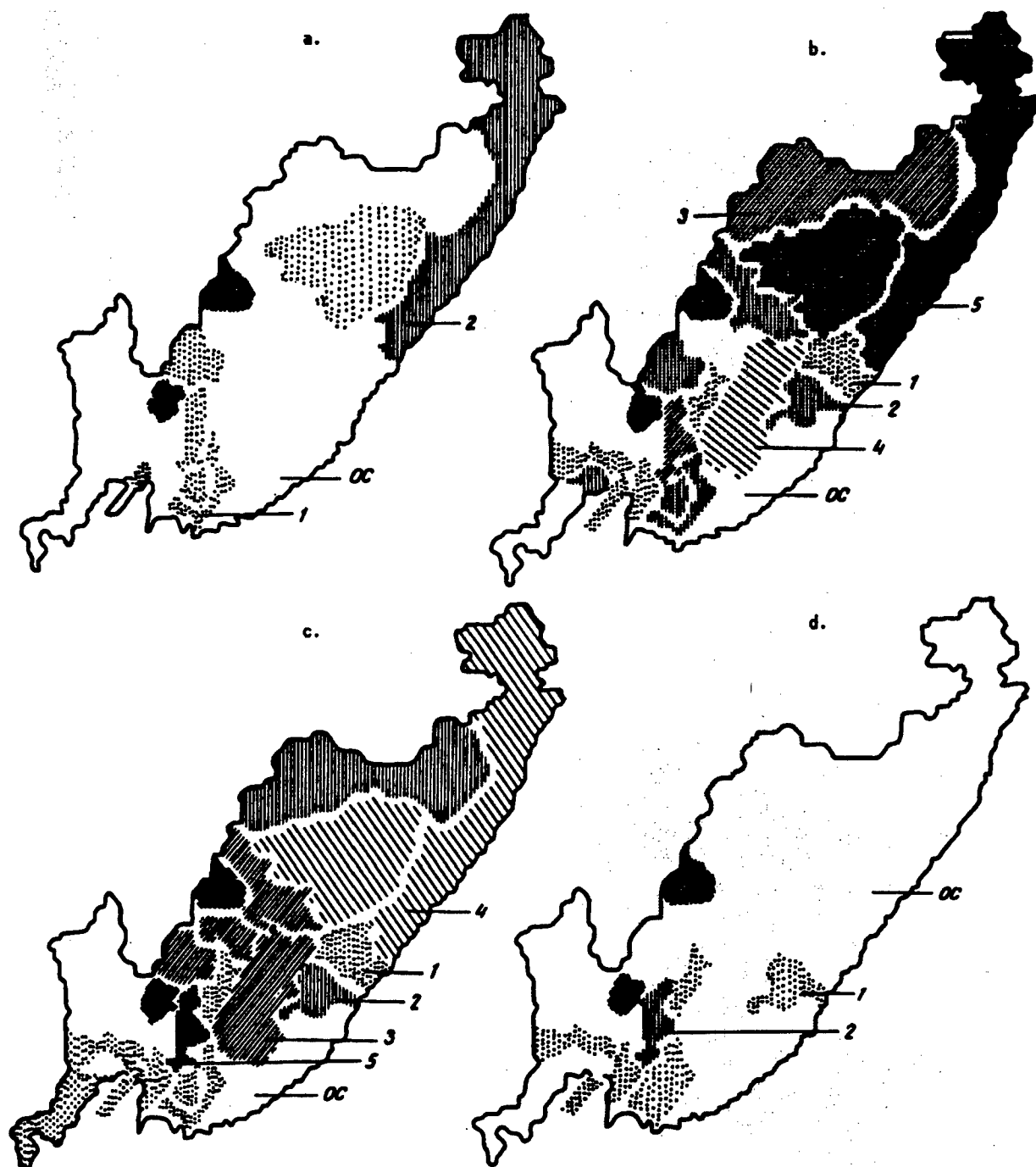
2: 6.00-15.99 per 100,000

3: 16.00-29.19 per 100,000

4: 29.20-48.19 per 100,000

5: 48.20-100.00 per 100,000

Fig. 1. Seasonality of TBE morbidity in the Maritime Kray.



a,b,c,d represent the mortality in April, June, July, and September, respectively.

| | |
|-------------------------------------|-----------------------------|
| 0C: absence of mortality | 3. 15.00-34.99 per 100,000 |
| 1. 0.01-5.69 per 100,000 population | 4. 35.00-44.99 per 100,000 |
| 2. 5.70-14.99 per 100,000 | 5. 45.00-100.00 per 100,000 |

Fig. 2. Seasonality of TBE mortality in the Maritime Kray.

In light of the fact that in April, deaths are recorded mainly in the northern area, and in August-September, mainly in the southern area, one can assume that such a trend should have some kind of explanation associated with differing functioning of the natural TBE focus in those areas, i.e., it can apparently be tied above all to the life cycles of the ixodic ticks, which have a leading epidemic significance.

As was demonstrated earlier with information analysis,³ the ticks *H. japonica* and *D. silvarum* have weak ties to TBE morbidity, whereas the opposite was identified for *I. persulcatus* and *H. concinna*: The first had a closer connection with severe clinical manifestation of TBE, the second, with a mild course of the infectious process. The viral potency of the taiga tick has always been higher than that of other species of tick.⁶ TBE morbidity in the kray is recorded in only those rayons which the taiga tick inhabits. Consequently, the nature of the epidemic process and the severity of the course of the infection are apparently linked to the life cycle primarily of the *I. persulcatus* tick.

In the northern mountain-forest region of the Sikhote-Alin ridge—for which a continental climate with a cold winter and a hot, dry summer is typical—the seasonal activity of the ticks begins and ends earlier than does that of the tick in the southern area. Previous studies indicate that.^{1,2,13} In addition, it is also known that in the Northern Primorye, the natural conditions predetermine the primarily three-year cycle of development of the taiga tick and more.^{10,16}

The elevated level of lethality in April is a result primarily of the northern rayons of the kray, where the taiga ticks are very active. Infection of people during that period apparently occurs as a result of the activation primarily of the younger and more aggressive specimens. Researchers turned their attention long ago on the seasonal physiological features of the imago.¹² During that period, apparently, conditions for the viability of the virus are also favorable in the body of the tick. Lethality at the end of the epidemic season rises primarily in the southern part of the kray, where the seasonality of the epidemic process is extended because of the elevated humidity of the air and the lengthy warm season. All that shortens considerably the periods of development of the larval and nymphal phases of the taiga tick.^{4,10,13}

The shortening of the development cycles of the ticks can also have a favorable effect on the status of the viral population. Earlier works by certain authors focused attention on the epidemiological significance of the autumnal activity of the female taiga ticks.¹³ For example, in 1958, five cases were recorded as late as October in just one rayon of Southern Primorye. The author attributes that to the possibility of individual specimens of the taiga tick maintaining reserves of food substances even to the end of October. However, the elevation of lethality in September to 40 percent leads to some doubt that, by the end of the lives of hungry ticks, when food substances have virtually completely disappeared, they would be capable of causing such severe forms of TBE. In that connection, one can allow another assumption consisting in the notion that it is more likely that an unfavorable outcome of the illness is possible from physiologically younger specimens, which

contain a highly virulent virus. Such specimens can be active imagoes that are not diapausing and that recently molted in August-September. Experimental field studies are under way in the natural foci of the southern part of the Far East to confirm that assumption.

Thus, computer mapping has demonstrated the broad possibilities of its application for conducting epidemiological analysis and for estimating the epidemic hazard of an area. The cartographic data obtained for morbidity and mortality as a function of date of infection made it possible to divide the focal area of Sikhote-Alin into a northern part and a southern part, with differing seasonalities for the epidemic manifestation of foci. Those maps can be used for conducting targeted prophylactic measures for preventing or lowering TBE morbidity.

Computer cartography can also be used in other focal areas of the USSR in the study of TBE as well as other diseases.

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Basic Features of the Epidemiology of Lyme Disease in the Northwestern USSR

927C0053B Moscow MEDITSINSKAYA

PARAZITOLOGIYA I PARAZITARNYYEBOLEZNI

in Russian No 3 May-Jun 91 [manuscript submitted

20 Dec 90]pp 14-17

[Article by E. I. Korenberg, R. I. Kuznetsova, Yu. V. Kovalevskiy, Z. Ye. Vasilenko, B. D. Mebel, Scientific Research Institute of Epidemiology and Microbiology imeni N. F. Gamaleya, USSR Academy of Medical Sciences, Moscow; Leningrad Oblast Health-Epidemiological Station; UDC 616.98:579.834.114]-036.2(470.23)]

[Text] Serological confirmation of the many cases of Lyme disease (LD), identification of natural foci in the northwestern USSR, establishment of the spontaneous infection of *Ixodes persulcatus* and *I. ricinus* ticks by the pathogen of that infection,^{5,7} and identification of isolates taken from them^{14,15} have served as the basis of a more detailed study of the problem of Lyme-borreliosis in the northwestern USSR. Various aspects of our work, which was conducted in a program approved by the RSFSR Ministry of Health, have already been published. This report summarizes data that was obtained in 1986-1989 in Leningrad Oblast and represents the first data for our country on the epidemiology of LD.

Owing to the fact that LD and tickborne encephalitis (TBE) have the same vectors and a similar geographic distribution,^{6,8} as well as to the possibility of the joint existence of the parasitic systems of those infections—which are completely different from each other etiologically—in the same areas,¹² we adjudged beforehand that their epidemiologies are probably similar.^{8,11} As a result, we decided to conduct a parallel analysis of materials involving LD and TBE, keeping in mind, however, that a detailed epidemiological description of TBE in Leningrad Oblast already exists in the literature.^{2,16}

Materials and Methods. Epidemiological maps and anamnesis data on all cases of illness identified by treatment facilities of the Leningrad Oblast and resulting from a tick bite in the spring-summer periods of 1986-1989 were analyzed. A diagnosis of LD was posted on the basis of typical clinical symptoms of the initial phase of the illness,¹⁷ as well as on the results of serological tests. Blood sera (in most cases, paired) were studied with indirect

immunofluorescence in a technique described earlier by Kryuchenikov *et al.*¹³ and involving the corpuscular antigen of the LD pathogen prepared by the Laboratory of Infection Vectors of the USSR Academy of Medical Sciences N. F. Gamaleya Scientific Research Institute of Epidemiology and Microbiology. In all, the sera of 577 individuals who became ill from a tick bite were tested, but in 1986, that number included only individuals in whom pronounced migrating erythema typical of the early stages of LD. The diagnosis of TBE was posted on the basis of clinical signs and was confirmed by the growth of titers of antihemagglutinins in sera tested in the generally accepted-method. Over the four-year period, 376 cases of LD and 132 cases of TBE were recorded among oblast residents (not counting Leningrad).

Results. LD was noted among the residents of more than 125 population centers in almost all the administrative rayons (in 13 of 17) of the Leningrad Oblast, which indicates the broad distribution of natural foci. In terms of number of cases, however, the rayons differ widely from one another. That stems from the features of the population of *Ixodes* ticks. Leningrad Oblast is known to have two main vectors of *Borrelia*: *I. persulcatus* and *I. ricinus*. In the different rayons, and often in different forests of the same rayon, the population and ratio of those species are vastly different: from a roughly equal percentage of both species to the absolute predominance of one over the other.^{7,19,20} More than 70 percent of the cases of LD are accounted for by five administrative rayons (Tosnenskiy, Volkhovskiy, Kirovskiy, Tikhvinskiy, and Kirishskiy), where *I. persulcatus* generally predominates. The highest levels of TBE morbidity are also noted in those rayons.¹⁶ Specifically, more than 50 percent of the cases of the neural infection recorded in the oblast during the years of our study were in those rayons. In addition, in Priozerskiy Rayon, where almost only *I. ricinus* is encountered,^{19,29} illnesses have not yet been noted, although *Borrelia* were isolated from ticks collected there in 1990 (data of N. B. Gorelova and M. L. Levin). Typically, on the Karelia Isthmus in recent years, after a stop was put to alimentary infections, there have been no cases of TBE.¹⁶

The features described of the nosogeography of LD in Leningrad Oblast, in our view, go beyond the framework of narrowly regional import. They are in complete agreement with the fact that the highest figures for infection of *I. ricinus* with *Borrelia* produced in various parts of the geographic range of that tick^{7,18,22,24} are, as a rule, below the known figures for *I. persulcatus*.^{7,10} Moreover, there exist certain differences in the degree of aggressiveness towards humans by the nymphal and imago phases of ticks of those species.⁴ All that gives reason to consider *I. persulcatus*, as with TBE, an epidemiologically more effective vector of LD than *I. ricinus*.

LD morbidity in Leningrad Oblast, according to existing data, has been 2.5- (1988) to 3.2-fold (1989) greater than the absolute and relative morbidity figures for TBE (Fig. 1). On the whole, over the four-year period, the number of cases of LD was 2.8-fold greater than the number of cases of TBE. In light of that, one should note that nearly 20

percent of the identified illnesses of borreliosis had an obliterated onset and were not accompanied by the typical migrating erythema.¹¹ A considerable portion of those cases were apparently unidentified, because many people in that situation do not see a doctor at all. As shown by special clinical-serological testing of the rural population, a symptomless course of the initial phase of the infectious process is observed rather often, and it is accompanied additionally by an active specific humoral immunity.^{1,9} Because of that, there is every reason to believe that the figures cited (see Fig. 1) are not entirely indicative of the actual situation, and the true LD morbidity is actually considerably higher. Even in such form, however, they convincingly support the notion already expressed by us earlier that LD is an infection that is far from sporadic for our country.^{8,11} On the whole, in terms of the level of morbidity, LD apparently leads TBE and, consequently, occupies one of the leading places among natural-foci zoonoses.

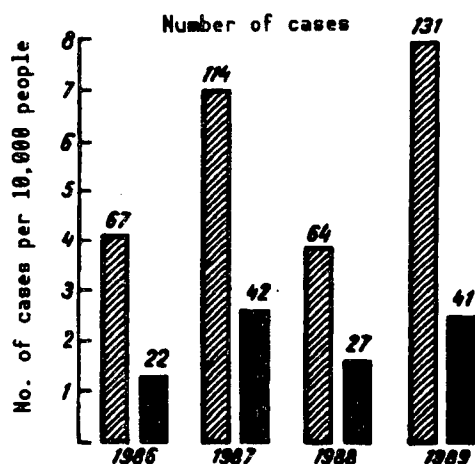


Fig. 1. Indicators for morbidity associated with LD (cross-hatched columns) and TBE (solid columns) in 1986-1989 in Leningrad Oblast

The changes in LD and TBE morbidity have similar trends over the years (see Fig. 1). That fact, extremely important from an epidemiological standpoint, indicates that the main biological and social factors determining the intensity of the epidemic manifestation of natural foci of LD and TBE are very similar. That does not preclude possible differences in the perennial dynamics of the loimopotential [loimopotential] of foci and morbidity, which may be associated primarily with the features of the ecology of the pathogens.⁸

In Leningrad Oblast, LD is noted from May through September. As with TBE, the cases are confined strictly to the period of activity of *I. ricinus* and *I. persulcatus* and have a seasonal distribution similar to that of TBE, with a peak in the first 20 days of June (Fig. 2).

In 330 cases, the precise dates of the tick bite and the onset of the borreliosis were documented. According to those

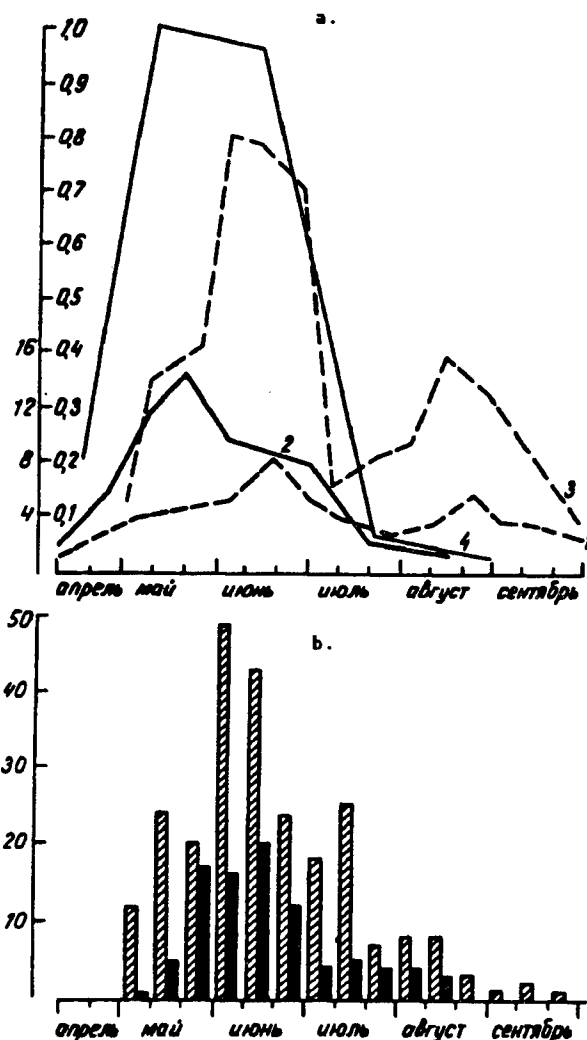


Fig. 2. Seasonal variations (according to P. Ye. Zolotov³) of the population of *Ixodes* ticks (top graph) and the distribution of the number of cases of LD (cross-hatched columns) and TBE (solid columns) by 10-day period in 1986-1989 (bottom graph).

Numbers on the left represent the number of imagoes (outside scale) and nymphs (inside scale) per flagohour [flago-chas]: 1—imago *I. ricinus*; 2—imago *I. persulcatus*; 3—nymphs *I. ricinus*; 4—nymphs *I. persulcatus*

data, which virtually coincide with the information published earlier,¹⁷ the incubation period was no more than five days in 23.3 percent, 6-10 days in 30.3 percent, 11-15 days in 25.8 percent, 16-20 days in 12.1 percent, and 21-25 days or more in 8.5 percent (an average of 10-12 days). That corresponds entirely to the nature of the shift in the seasonal distribution of LD in terms of the curve for seasonal activity of adult *I. persulcatus* ticks and confirms their preeminent role as vectors of borreliosis in Leningrad Oblast. In addition, the length of the season that is hazardous in terms of LD is roughly one month longer

than that for TBE. A few cases of LD appeared as late as September (1.6 percent of the total number). That is undoubtedly associated with the features of the seasonal activity of the *I. ricinus* imagoes and nymphs. The absence of TBE cases at that time is apparently explained by the extremely low (nearly 0.01 percent) infection rate of *I. ricinus* by the virus.²¹

Like TBE, Lyme disease is noted in people of all ages, with the distribution of both illnesses generally rather similar among the age groups (Fig. 3). More often than not, adult able-bodied individuals (20-59 years of age) contract the diseases, representing more than half of all cases. Preschool children and school children (under 14 years of age) constitute a relatively large group of LD patients (16.7 percent) and TBE patients (17.5 percent). Children 1-2 years of age represent 2.6 percent of all LD cases, whereas TBE is not noted in such a young age group.

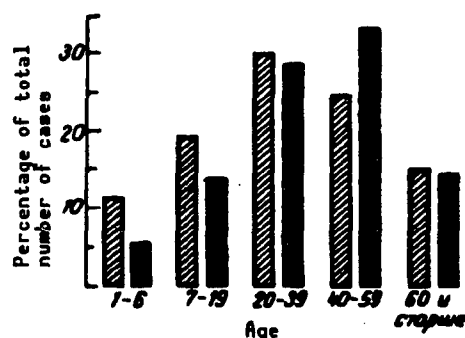


Fig. 3. Distribution of LD (cross-hatched columns) and TBE (solid columns) by age group

Both the age makeup and the socio-occupational makeup of those contracting disease (see the table) are determined by the forms and causes of contact between the people and the ticks and natural foci. Infection occurs when ticks bite individuals primarily during work or recreation in their own gardens or when the individuals visit forest areas for day-to-day purposes.^{7,16} The high LD morbidity rate we identified earlier⁷ among residents of the city of Leningrad merits separate epidemiological analysis. Here we should at least mention that, as with TBE,² city dwellers are infected mainly in the areas of the same administrative rayons of the oblast in which the oblast's rural residents are infected, by coming in contact with the ticks mainly in the same ways as described above. Occupational links to forests do not have any appreciable significance. Those who become ill are mainly workers and employees, as well as pensioners and people doing household chores and school children and preschool children. The last three groups of people represent a total of roughly 42 percent of LD and TBE cases (see the table).

Distribution of LD and TBE by socio-occupational group

| Population group | Total number of cases, percent | |
|---|--------------------------------|------|
| | LD | TBE |
| Workers and employees | 48.1 | 42.8 |
| Agricultural workers | 5.3 | 8.8 |
| Forestry and land improvement workers | 4.5 | 6.6 |
| Pensioners and non-working people | 25.3 | 17.6 |
| School children and students of occupational training schools | 8.6 | 18.7 |
| Preschool children | 8.2 | 5.5 |

Discussion. Thus, the materials presented here indicate that distribution, seasonality, routes of infection and main LD and TBE vectors, causes of contact between the population and the natural foci and the ticks, and age and socio-occupational makeup of those who contract borreliosis and encephalitis in Leningrad Oblast are very similar. On the whole, that fully supports the position that the main features of the epidemiology of the two etiologically different infections, whose pathogens are linked very closely in our country to *I. persulcatus* and *I. ricinus* ticks, are basically the same.^{8,11}

The features of the ecology of the pathogen of LD and the pathogen's relationship to other co-members of the parasitic system, which have yet to be studied, are the reason for a level of infection rate among ticks^{5,7,10} that is incomparably higher (for Leningrad Oblast, 100 times higher) than with TBE.²¹ It is that, primarily, that explains the considerably higher overall level of LD morbidity, as well as a probability of infection among preschool children that is greater than for TBE, the contact with ticks being the same. One cannot preclude the possibility of transplacental transmission of *Borrelia*, which has been reliably established for the LD pathogen.²³

Earlier, we turned our attention to the fact that, because of common character of the vectors, the association of parasitic systems, and the similarity of the epidemiology of LD and TBE, special epidemiological significance attaches to the probability of simultaneous infection by the two pathogens and mixed infection.^{6,11} The possibility has been demonstrated of the simultaneous, spontaneous infection of the ticks with the LD pathogen and the TBE virus,¹² and the first case of mixed infection has also been described.^{7,17} In 1986-1989, among patients from Leningrad Oblast, seven individuals were identified in whom, judging from the clinical signs and the rise intiters of specific antibodies to the LD and TBE pathogens, there was a pronounced degree of mixed infection. That group

accounts for about 3 percent of the total number of LD patients and about 8 percent of the number of TBE patients, which confirms the great practical importance of this problem, which is essentially completely new for our health care sector.

Conclusions. 1. Lyme disease and tickborne encephalitis have similar basic features of epidemiology, which is linked to the common character of the main vectors and factors determining the possibility of human infection.

2. The level of LD morbidity is considerably higher than that of TBE. That indicates the extremely important role of LD in today's infectious pathology and requires the solution of many scientific and applied problems associated with the infection.

3. In regions endemic in terms of LD and TBE, cases of simultaneous infection by the two pathogens of the diseases are possible.

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Morbidity Associated With Tick-Borne Relapsing Fever in the Western Pamirs

927C0053C Moscow *MEDITSINSKAYA PARAZITOLOGIYA I PARAZITARNYYE BOLEZNI in Russian* No 3, May-Jun 91 [manuscript submitted 30 Jul 90] pp 22-24

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[Text] Tickborne relapsing fever (TRF) has long been widespread in the Western Pamirs. But there has been nothing published on TRF morbidity in that region since the expedition led by Academician Ye. N. Pavlovskiy in the 1930's.^{3-5,7} This report presents materials on that morbidity in the Western Pamirs at the present time and discusses the changes that have taken place over 50 years.

Materials and methods. Morbidity was assessed on the basis of archive materials of the republic health-epidemiology station and rayon stations for 1986-1989 in all rayons of the Western Pamirs—Kalay-Khumbskiy, Vanchskiy, Rushanskiy, Shugnanskiy, and Ishkashimskiy rayons. For purposes of comparison, we used the same materials for the republic as a whole. All cases of TRF were

established on the basis of the presence of the pathogen *Borrelia sogdiana* in a large drop of blood during the testing of feverish individuals for malaria. We used data on the population size of the tick-vector *Ornithodoros papillipes* Bir, the rate of its infection by *Borrelia*, and the results of surveys of the local population about tick bites. We obtained the last group of data in a survey of 11 population centers in the Pyandzh Valley from Kalay-Khumb to Langar, located near the sources of the Pyandzh at the confluence of the Pamir-Darya and the Vakhn-Darya. Those materials are elaborated in detail in a previous report.²

Results. Tick-borne relapsing fever in the Western Pamirs in 1986-1989 was widespread in population centers of the lower and middle parts of the valley of the Pyandzh (hereinafter, we are speaking only of the part of the Pyandzh valley that belongs to the Western Pamirs) and its tributaries, and morbidity was considerably higher than in other rayons of the republic (its incidence per 10,000 population was 3.8 and 0.2, respectively). The highest morbidity rate was in the Kalay-Khumbskiy and Vanchskiy rayons (in certain years, incidence reaches 8-9/10,000—see Fig. 1, left); the rate was somewhat lower in Rushanskiy Rayon (where the maximum incidence was 3.2/10,000). In Shugnanskiy Rayon, TRF was recorded in Khoroga only. Along the upper course of the Pyandzh (Ishkashimskiy Rayon), no cases of TRF were known of during those years, although two individuals diagnosed in Dushanbe are thought to have become infected when they were visiting that rayon.

The dynamics of the morbidity varies from rayon to rayon. In Kalay-Khumbskiy Rayon, it grew steadily during the observation years; in Vanchskiy and Rushanskiy rayons, after a maximum in 1987, it declined steadily (see Fig. 1, left). The morbidity season is longest in Kalay-Khumbskiy Rayon at nine months: from March through November (see Fig. 1, right). In other rayons located at high altitudes, the drier, cooler climate results in the season of activity of the vector and, consequently, the season of morbidity beginning later and ending earlier. Everywhere, the peak in morbidity is in July; but if Kalay-Khumbskiy Rayon accounts for one-third of the cases during that month, Rushanskiy Rayon accounts for more than half. The relationship of the dynamics of morbidity in the various rayons—its similarity in Vanchskiy and Rushanskiy rayons, and its noticeable differences in Kalay-Khumbskiy Rayon—corresponds to the natural regionalization of the Western Pamirs.² In the other parts of the republic, where altitudes are lower and climate hotter, cases are recorded year-round, with the maximum shifted to the end of spring and beginning of summer (May, June, rarely July).

Typically, TRF is spread out, and cases are sporadic. In the various rayons, cases are identified in 23-33 percent of settlements. In roughly half of 45 population centers where TRF has been recorded, there was one case in each over the four study years, with a maximum number (15 cases) noted in only one settlement (Fig. 2). Four years in a row, TRF was identified in only two population centers.

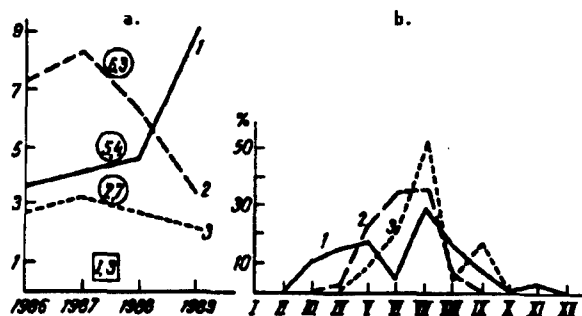
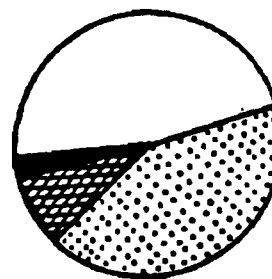


Fig. 1. Dynamics of TRF morbidity in the Western Pamirs by year (left graph) and by season (right) for 1986-1989

Left, x-axis represents years, y-axis represents incidence per 10,000 population. Numbers in circles are average incidence over four years; numbers in square, same for city of Khoroga. Right, x-axis represents months, y-axis represents number of cases (in percent). 1—Kalay-Khumbskiy Rayon; 2—Vanchskiy Rayon; 3—Rushanskiy Rayon



Number of settlements in which cases were noted over the years

- 1 case
- 2-3 cases
- ▨ 4-9 cases
- (15 percent)

Fig. 2. TRF morbidity in various population centers of Western Pamirs in 1986-1989

The predominate portion of the individuals diagnosed with TRF are local residents and only about 5 percent were nonresidents. Individuals of all age groups come down with TRF, but it affects mainly children and adolescents (about 80 percent of cases, Fig. 3). TRF is noted very rarely in people over 30. A few cases have been identified in people 65-75 years of age. No clear-cut differences have been noted in the distribution of TRF cases by age group in the various rayons. However, the age composition in the Pamirs has been consistently different from that in the rest of Tajikistan: in the Pamirs, the percentage of children under 16 who have come down with the illness is larger (42 percent versus 25 percent), whereas the percentage of

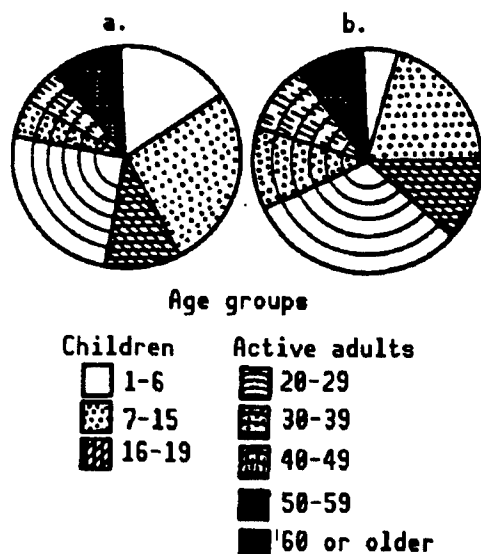


Fig. 3. TRF morbidity for various age groups of the population in the Western Pamirs (left) and in the rest of Tajikistan (right) in 1986-1989 (in percent)

active adults who have come down with it is smaller (37 percent versus 54 percent; Fig. 3). Slightly more women are noted to come down with the illness in the Pamirs (1:1.2), with the greatest predominance noted in the 20-29 and over-50 age groups (1:1.7); in the rest of the republic, no differences in morbidity are noted between men and women.

We can judge about the changes that have taken place since the publications of the 1030's from indirect data only, because no specific materials on levels of morbidity were published around that time. If the clinical picture of TRF was well known to the local population and medical workers, and if Ye. N. Pavlovskiy's expedition was able to use anamnestic data to identify individuals with TRF and individuals who had previously contracted TRF,³⁻⁵ that infection is virtually unknown not only to the population, but also to physicians. Diagnosis is made by workers of the health-epidemiological station with laboratory testing of the blood of fever-ridden individuals for malaria. That, undoubtedly, points to a substantial decline in morbidity. But it has been weaker, apparently, than in other parts of the republic, because the foci of TRF have changed to a lesser extent, because of the remoteness of the Pamirs from the center and because the Pamirs are not very accessible. It is known that before, just like the Pamirs, the center and some of the south of Tajikistan (the Hissar slopes, the vicinity of the city of Kulyab, etc.) were replete with classical foci of TRF with extremely high morbidity rates.⁶ Now only a few cases are recorded.

The distribution of TRF has changed somewhat in the Western Pamirs. Before, the illness was noted in all of the valley of the Pyandzh; now most of the cases are confined to the lower part of the valley. One possible reason is subjective. Along the upper course of the Pyandzh, in the

Ishkashimskiy Rayon and in almost all the Shughnanskiy Rayon, blood is not tested for malaria. For that reason, although no cases of TRF have been identified in those rayons, the situation is not clear, because the foci of the infection, as our investigations show, have remained.² That TRF still exists there is indicated by the fact that two residents of Dushanbe contracted the illness after visiting kishlaks [villages in Central Asia] in the Ishkashimskiy Rayon. Nevertheless, one cannot tie the features of the distribution of TRF with just diagnostic deficiencies. The decline in morbidity going upriver along the Pyandzh is seen also in rayons in which diagnostics have been set up. For example, in the Rushanskiy Rayon, in the middle part of the valley, morbidity is considerably lower than in the lower rayons of Vanchskiy and Kalay-Khumbskiy.

In the 1930's, in the Western Pamirs, TRF was contracted by nonresidents only, and the local population was immune.^{3-5,7} Today, large contingents of nonresident military, construction workers, and other workers, who used to constitute most of those who contracted the illness, have virtually no contact with places where ticks are found, and they don't need to spend the night in adobe houses in the kishlaks, much less go into barns. The relatively small percentage of nonresidents who contract the illness today are, as a rule, people visiting their relatives in the Pamirs while on vacation. The occurrence of cases of the illness among local residents is linked to some extent to the expansion of the medical network and to more visits made to physicians. The main reason, however is, in our view, the decline noted in the Pamirs (and everywhere in the geographic range) of the vector population. Today's vector population is big enough for periodic contacts between residents and ticks, but too small to support immunity in a considerable portion of the local population. It must be kept in mind that our data and the data of the literature show that there are almost always infected specimens in the natural populations.^{1,8} The loss of immunity is confirmed by the existence of TRF cases among people over 30 (more than 20 percent of the cases) and even among elderly people.

It is not precluded, however, that a given immune stratus still exists at this time, and that the size of it varies, apparently, from rayon to rayon. According to our data, the population of ticks is smallest in Kalay-Khumbskiy Rayon; that population grows as we move upriver along the Pyandzh, but it varies substantially from region to region.² As we move deeper into the Pamirs, apparently, the infection rate of the populations of the vector of the TRF pathogen grows. A check of all of the 15 batches of ticks that were collected revealed three strains of *B. sogdiana*, and two of them were from Langar [a kishlak]. At the same time, the possibility of contact with ticks is increasing, because the old custom of building living quarters right next to barns is being seen more and more often. The surveys we made of the local population revealed that residents were well aware of the ticks and complained of regular bites only in areas in which such structures were the most widespread, and specifically in the kishlaks of Langar and Zong, which are located along the upper course of the Pyandzh. Before, that was true

everywhere. Thus, the decline in morbidity as we go upriver along the Pyandzh takes place against the backdrop of an increase in vector population and infection rate and possibility of contact with the vector. Those indices, which determine the possibility of infection, are highest in Langar and Zong, but no cases of TRF have been identified in those kishlaks. A physician who has worked in those kishlaks for many years confirmed that he has never encountered any individuals with the clinical symptoms of TRF. One can assume that in Kalay- Khumb'skiy Rayon, the high morbidity rate—with the smallest vector population and the smallest possibility of contact with the vector—is due to the absence or low level of immunity among local residents. Going upriver along the Pyandzh, the percentage of immune population apparently grows gradually, reaching a level in Langar and Zong that is close to what existed in the 1930's. Pointing to some extent to the immunity that exists in some segment of the population in the Pamirs is the fact that the percentage of children among those who have contracted the illness there is higher than in other parts of the republic where morbidity is considerably lower.

Conclusion. Tick-borne relapsing fever at present is widespread in the Western Pamirs in population centers of the Pyandzh river valley. Morbidity, although lower than in the 1930's, is still rather high. Most of the individuals who contract the illness are local residents, who did not used to be susceptible to the infection, which is apparently due to the decline in the vector population to a level that leads to a loss of immunity among part of the human population, but that is sufficient for periodic contacts with infected ticks. To some measure, the collective immunity against TRF in the Pamirs seems to be intact. The lack of uniformity in the distribution of cases of the infection and the absence of such cases in TRF foci along the upper course of the Pyandzh may be due to differences in the level of immunity.

Although the nature of the changes in the TRF situation in the Pamirs over 50 years is typical of all the nosogeographic range of that infection, the Pamirs differ from the rest of the republic in terms of a higher level of morbidity, the seasonality of morbidity, and the age composition of the individuals who contract the infection. Those differences are due, on the one hand, to abiotic factors—chiefly, climatic conditions—and, on the other, to a greater degree of preservation of the TRF foci and the contact of the human population with them as a result of the remoteness and inaccessibility of the Western Pamirs.

The elimination of TRF diagnostic deficiencies, the testing of the blood of fever patients everywhere in the vector geographic range, and the further study of the factors determining the level of morbidity at this stage will enable us to comprehensively evaluate the situation, which is necessary for cleaning up the TRF foci in the Western Pamirs and in all of Tajikistan.

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Features of the Epidemic Activation of the Natural Focus of Zoonotic Cutaneous Leishmaniasis in Locales of Sympatric Incidence of *Leishmania Major*, *L. Turanica*, and *L. Gerbilli*

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[Text] Researchers studying the problem of zoonotic cutaneous leishmaniasis (ZCL) in the USSR have noted more than once that there exists only a partial matchup between the incidence of leishmaniasis epizootics among great gerbils (*Rhombomys opimus*) and ZCL among humans.^{1,10,12}

Long-lasting, intense leishmaniasis epizootics among great gerbils have been recorded across broad areas of Iran, northern Afghanistan, and the desert regions of the USSR and in Mongolia and the northeastern deserts of China. However, illness among humans living in locales in which the great gerbil lives is noted in only the southwestern part of the geographic range of that rodent and is confined to local, often isolated areas of those regions. In flat, typically desert regions, the natural foci of ZCL are almost without exception safe in terms of epidemics. Cases of the illness among humans are extremely rare. A high ZCL morbidity rate among humans is noted in desert regions bordering the mountains, where there is a surface or subsurface flow of water, as well as in river valleys and in areas between oases and deserts. But the morbidity rate in such areas is not stable, and periods of massive illness alternate with periods of safety in terms of epidemics.^{2,3}

A revision of the taxonomic status of leishmania associated with the great gerbil has shown that not one, but three species of leishmania circulate in the populations of that rodent.^{13,15} Of those three, only *L. major* (in a new

concept) is a species pathogenic to humans, whereas the other two—*L. turanica* and *L. gerbilli*, which were previously identified with *L. major*, are not pathogenic to humans.

The discovery of sympatric species of pathogenic and nonpathogenic leishmania in populations of the great gerbil opens new promising possibilities for territorial demarcation and prediction of epidemically hazardous and epidemically nonhazardous epizootics.

The purpose of this paper is to analyze the features of the development and epidemic manifestation of epizootics of leishmaniasis in the great gerbil in locales in which the three species of leishmania are found. The analysis was done on the basis of results of field observations performed in Uzbekistan in the Karshi Steppe in 1975-1978 and 1985-1988.

Material and Methods. A description of the work location. The area in which the observations were made belongs to the second phase of development of the Karshi Steppe, where the development of a large desert tract was continuing and four new state farms, Nos. 51-54, were being built. Before the development, large settlements of the great gerbil that overlapped one another were found in the tract, and about 15,000 colonies were recorded when the area was being mapped in 1975-1977. The natural foci were typical of the desert: in 1978, examination showed *P. caucasicus* to be the dominant vector and *P. mongolensis* to be the subdominant vector.

The population of those vectors varied from 0.01 to 9.8 sand flies per counting sheet. *P. papatasi* was encountered everywhere, but its population was very small (on average, 0.1 sand fly per sheet). The infection rate among the great gerbil varied from 54 percent to 100 percent. Among the *Leishmania*, as later investigations demonstrated, it was mainly *L. turanica* that was circulating, but *L. major* was encountered very rarely. There were two large cattle-breeding population centers in that area. Examination of the residents in 1978 showed that ZCL morbidity there has not been noted for at least the last 80 years, with only the first local cases of the illness showing up in 1987.

Development of the area for the state farms was effected in various period of time between 1983 and 1986. As a rule, the sectors that were developed were irrigated by the second year after the development had begun. Irrigation of state farms Nos. 51 and 52 began three years before the activation of the natural focus; irrigation of state farm No. 53 began two years before activation; and irrigation of state farm No. 54 began during the year of activation of the natural focus. However, unlike the area involved in the first phase of irrigation and development of the Karshi Steppe,^{8,11} the tract under development was not isolated from the desert, and right up until 1988, the possibility of the gerbils entering from the desert remained in certain sectors.

Beginning in 1984, the entire development tract was exterminated, and all the gerbil settlements that had existed initially were eradicated by 1986 as a result of the inoculation of the burrows with poisoned grain, and most of the spots suitable for gerbil habitation were plowed

during preparatory irrigation-reclamation operations. After the gerbil settlements in the land under development were eliminated, gerbil settlements in a 3-km-wide strip around the tract were inoculated with poisoned grain for two years in a row (1986-1987) in an attempt to set up a protective barrier, but that did not keep the gerbils from escaping to the area under development. Colonies of the great gerbil were found on the four state farms in December 1987. In all, from that December through May 1988, a comprehensive investigation of the area of the state farms found and mapped 898 great-gerbil living colonies, which were poisoned with grain in stages,⁸ and as of mid-July 1988, they were designated nonliving colonies.

The first cases of ZCL among the residents of the four state farms were recorded in the autumn and winter of 1987. In 1988, more cases were identified, but there were fewer of them.

Material-collection sites. Sectors were chosen that were confined to various types of natural focus: desert, near-oasis, and oasis.⁷ The sectors on state farms Nos. 51-54 were selected in December 1987. In the selected sectors, samples of sand flies, leishmania, and vertebrate hosts were obtained 1-3 times a year.

Evaluation of the species composition and population size of the sand flies. At the peak of flight of sand flies of the first and second generation, populations counts were made of the sand flies in the gerbil burrows. For that, 10 standard sheets of paper smeared with castor oil were placed for a night in each of 10 gerbil colonies.⁵ The sand flies were identified as to species, and indices of abundance and dominance were calculated. In all, 31,053 sand flies were caught.

Extracting isolates of leishmania. Some 20-40 great gerbils were removed from each sector, and red-tailed gerbils were removed if they were there. Leishmania were removed from all the captured animals whose ears were uninjured by means of seeding with a syringe the contents of an extract from the affected sector of skin into a nutrient medium NNN with the addition of antibiotics in the amount of 250 U penicillin and 250 mg streptomycin per 1 ml of liquid phase of the medium. From all the animals we prepared smears that were subsequently examined under a microscope. A total of 237 isolates of leishmania were extracted and identified: 234 from great gerbils and three from red-tailed gerbils. A total of 1,498 smears were examined.

Identification of the leishmania was done with electrophoresis in PAGE with eight enzymes—PHI [FGI], PHM [FGM], 6-PHD [6-FGD], ME [MYe], H-6-PHD [G-6-FGD], AST, ALT, MDH [MDG]—and some of the isolates were identified also with SOD [SOD], NH [NG], Est. D [Est. D].¹⁴ The following strains served as markers: *L. major*—MRHO/SU/59/Neal P; *L. turanica*—MRHO/SU/82/CL.3720 or MRHO/SU/83/KD-051; *L. gerbilli*—MRHO/CN/60/gerbilli.

Examination of population. In December 1987, the population of the state farms was examined via checkups made of all individuals who had been identified up to that time as having contracted leishmaniasis. In 1988, from September through December, examiners went farm to farm

and examined the residents of the four state farms (8,800 individuals). The diagnosis of cutaneous leishmaniasis was made on the basis of the clinical course, and in some individuals, the diagnosis was confirmed parasitologically.

Results. A comparative description of vectors in oasis and desert settlements of the great gerbil is presented in Table

1. For desert settlements of *R. opimus*, dominance of sand flies of the subgenus *Paraphlebotomus* (60 percent) is typical: *P. caucasicus*, *P. mongolensis*, and *P. andrejevi*, whose indexes of abundance vary from 0.2 sand fly per stick sheet to 7.0. The population of *P. papatasi* in those settlements was small, with an index of abundance of 0.03-1.4 sand flies per sheet.

Table 1. Abundance of Leishmania Vectors and Dominance of *P. papatasi* in Various Types of Great-Gerbil Settlements

| Type of natural focus | Colonies studies | Sand fly total | Index of abundance | | | | Dominance of <i>P. papatasi</i> , in percent |
|---|------------------|----------------|--------------------|----------------------|-----------------------|---------------------|--|
| | | | <i>P. papatasi</i> | <i>P. caucasicus</i> | <i>P. mongolensis</i> | <i>P. andrejevi</i> | |
| Desert, with hyperthermal conditions in burrow | 57 | 5614 | 0.3 | 0.6 | 0.1 | 0.3 | 30.0 |
| Near oasis, with mesothermal conditions in burrow | 47 | 1116 | 3.2 | 0.8 | 0.3 | 0.0 | 74.4 |
| Oasis, on edge of desert, with mesothermal conditions in burrow | 45 | 2333 | 1.2 | 0.5 | 0.1 | 0.0 | 66.7 |
| Oasis, in inoculation zone, with mesothermal conditions in burrow | 52 | 6847 | 11.9 | 1.4 | 0.3 | 0.0 | 87.5 |

In great-gerbil oasis settlements located in the zone of irrigated plantings, *P. papatasi* was dominant (87 percent), and its abundance index was 40-fold that in the desert. A *P. papatasi* population four times bigger than that in the desert was noted in peripheral sectors of the oasis, and a population 10 times bigger than that in the desert was noted in the zone of influence of irrigation water.

The infection rate of the great gerbils and the red-tailed gerbils by leishmania is given in Table 2. The total infection rate of the great gerbils by the leishmania of the three species, as determined in the examination of the smears and the recording of the external traits, both in the epidemically safe 1986 and in the period of epidemic activation of the natural focus in 1987-1988, was similar and varied from sector to sector at the end of the transmission season (September) between 40 percent and 87 percent.

Table 2. Rate of Infection by the Three Species of Leishmania of the Great Gerbils and Red-Tailed Gerbils Living in Different Types of Natural Foci

| Type of natural foci | Date of study | Number of <i>R. opimus</i> studied | Percentage with leishmania in smears and inoculations | Number of <i>M. libycus</i> studied | Percentage with leishmania in smears and inoculations |
|--|---------------|------------------------------------|---|-------------------------------------|---|
| Desert, with hyperthermal conditions of burrow | Sep 1986 | 28 | 67 | 0 | 0 |
| | Sep 1987 | 29 | 79 | 0 | 0 |
| | Sep 1988 | 40 | 34 | 0 | 0 |
| | Dec 1987 | 34 | 32 | 0 | 0 |
| | May 1988* | 58 | 10 | 0 | 0 |
| | Sep 1988 | 35 | 50 | 0 | 0 |
| | Nov 1988 | 28 | 71 | 0 | 0 |
| | Sep 1986 | 33 | 97 | 16 | 0 |
| | Sep 1987 | 34 | 64 | 13 | 0 |
| | May 1988* | 50 | 37 | 12 | 0 |
| | Sep 1988 | 30 | 81 | 27 | 0 |
| | Nov 1988 | 28 | 89 | 6 | 1 |
| | Sep 1986 | 27 | 85 | 2 | 0 |
| | Sep 1987 | 30 | 80 | 14 | 0 |
| | Sep 1988 | 31 | 97 | 7 | 0 |

Table 2. Rate of Infection by the Three Species of Leishmania of the Great Gerbils and Red-Tailed Gerbils Living in Different Types of Natural Foci (Continued)

| Type of natural foci | Date of study | Number of <i>R. opimus</i> studied | Percentage with leishmania in smears and inoculations | Number of <i>M. libycus</i> studied | Percentage with leishmania in smears and inoculations |
|--|---------------|------------------------------------|---|-------------------------------------|---|
| Near oasis, with mesothermal conditions of burrow | May 1988* | 74 | 14 | 0 | 0 |
| | Nov 1988 | 30 | 80 | 0 | 0 |
| | May 1988* | 24 | 21 | 15 | 0 |
| | Sep 1988 | 41 | 85 | 5 | 0 |
| | Nov 1988 | 33 | 88 | 0 | 0 |
| Oasis, in zone of plantings, with mesothermal conditions of burrow | Dec 1987 | 42 | 20 | 46 | 2 |
| | May 1988* | 79 | 9 | 0 | 0 |
| Nov 1988 | 15 | 60 | 53 | 1 | |

*The transmission of leishmania among the animals of the current year of birth had not begun, and the infection rate was computed among the group of animals who had gone through a winter.

However, the infection rate among the great gerbils by *L. major* varied considerably from year to year and, beginning in 1987, also between desert and oasis sectors (Table 3). In 1986, the epizootics of leishmaniasis in the gerbil settlements in all the sectors studied were caused by

leishmania whose composition was dominated by the epidemically safe species *L. turanica*. During that period, the frequency of detection of *L. major* on average was 1.5 percent. Moreover, with the existing selection, *L. major* was not found in most of the sectors studied.

Table 3. Results of the Identification of Isolates of Leishmania From Great Gerbils

| Type of natural focus | Year | Number of identified isolates | | | | | Frequency of extraction of leishmania, in percent | |
|---|------|-------------------------------|-----------------|--------------------|--------------------------------------|---|---|-------|
| | | <i>L. turanica</i> | <i>L. major</i> | <i>L. gerbilli</i> | <i>L. major</i> + <i>L. turanica</i> | <i>L. major</i> + <i>L. turanica</i> + <i>L. gerbilli</i> | | |
| Desert, with hyperthermal conditions in burrow | 1985 | | | | | | | |
| | 1986 | | 68 | 67 | 0 | 0 | 1.5 | 100.0 |
| | 1987 | | 34 | 31 | 0 | 1 | 5.9 | 100.0 |
| | 1988 | | 51 | 37 | 7 | 2 | 23.5 | 86.3 |
| Oasis and near-oasis areas, with mesothermal conditions in burrow | 1987 | | 15 | 7 | 4 | — | 53.3 | 73.3 |
| | 1988 | | 69 | 23 | 35 | 4 | 60.9 | 49.3 |

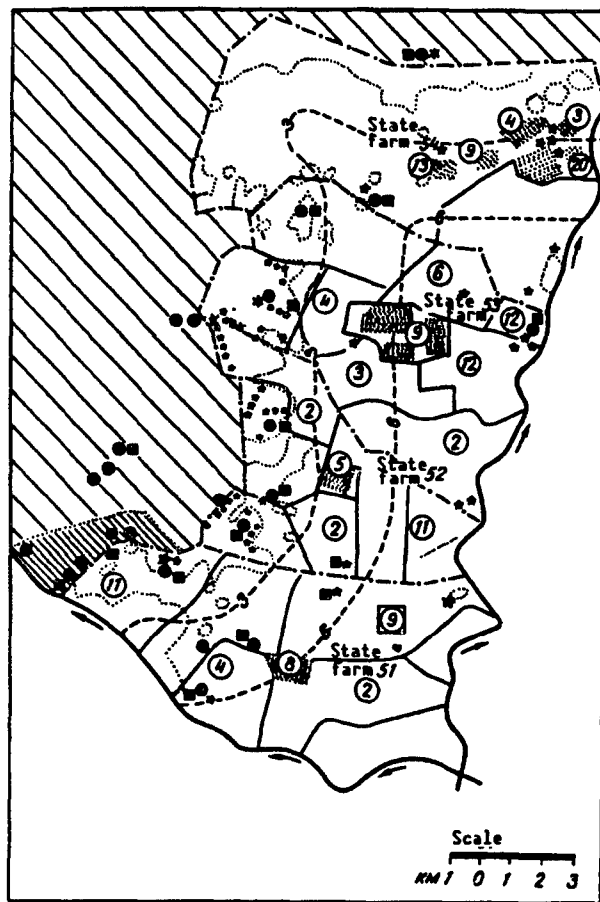
In 1987, there was a growth in the detection of *L. major*, which was different in the desert settlements from that in the oasis settlements: in the desert settlements, the frequency of detection of *L. major* increased fourfold; in the oasis settlements, 48-fold. The growth in the percentage of *L. major* continued also in 1988. By comparison with the initial epidemically safe period, *L. major* was encountered 27 times more often among infected great gerbils in desert settlements; in oasis settlements, together with similar near-oasis settlements, it was encountered 83 times more often. The growth in the percentage of *L. major* took place as a result of the growth in the percentage of mixed isolates consisting of clones of *L. major* and *L. turanica*.

Within the tract for the development of the land for state farms Nos. 51-54, *L. major* and *L. turanica* were found in all 11 intraoasis sectors that were studied, including small island settlements of gerbils and even isolated colonies

distant from one another (see the figure). At the same time, outside the tract of developed land, a large percentage of *L. major* was found in only a relatively narrow strip of desert adjacent to the western edge of state farm No. 51 (see the figure).

The percentage of *L. major* among infected great gerbils on the same sector fluctuated over the course of a year's time. For example, among great gerbils trapped on the state farms in December 1987, the percentage of *L. major* was 94 percent; in May 1988, it was 8 percent in those same colonies.

Among red-tailed gerbils, animals infected with leishmania were rarely found (1.9 percent), although the red-tailed gerbil population was large in certain sectors. All the finds of infected red-tailed gerbils were in sectors inhabited by those gerbils and great gerbils among whom the



- ☐ Central farmstead of the state farm
- ☐ Desert-type settlement of great gerbils
- Near-oasis-type settlement
- *L. major*
- *L. turanica*
- *L. gerbilli*
- ★ Colonies of great gerbils settled in the spring
- ★ Colonies settled in the fall
- Settlements of great gerbils existing before land development and eradication measures
- Distance from border with desert (in km)
- Numbers in circles represent number of humans contracting ZCL

The dot-dash lines represent the boundaries of the state farms; the solid lines represent the boundaries of the brigades and divisions.

percentage of *L. major* was high. All the leishmania-infected red-tailed gerbils were found in November-December, and the isolates obtained from them were identified as *L. major*.¹³

Nature of the colonization of the oasis area by great gerbils in 1988 (see the figure). A complete study of the area covered by the four state farms in September-December 1988, whose purpose was to ascertain why humans were still at risk of contracting ZCL after the burrow inoculation operations, made it possible to identify—in the heart of the tract, 4-6 km from the border with the desert—21 living

colonies of great gerbils. The exterior of the colonies indicated that they had been there for no more than 4-5 months, i.e., they had not been treated during the spring extermination measures. Evidence of that was provided by the following: the exterior of the colonies (the colonies were large in area, with well-kept burrow entrances), the number of animals (5-12), and the location of the colonies on sites atypical of gerbils (plowed field, cattle-drive trail). Along the edge of the developed tract, 39 colonies were identified, and the exterior of the overwhelming majority of the colonies indicated that they had been there no more than 1-1.5 months, i.e., they had been established as a result of a fall colonization by great gerbils from the adjacent desert. Evidence of that was provided by the number of animals (1-2), the poor condition of the burrow entrances, and the smallness of the colonies. All the colonies were located on spoil banks of the drainage intercepting ditches along the backfilled trenches enclosing drains, i.e., in places that are typically inhabited by gerbils and that must be checked during extermination operations. The gerbils went no further than 2 km into the developed area.

ZCL morbidity rate among humans. In the fall and winter of 1987, a total of 441 residents of the four state farms were identified as having contracted ZCL: 260 on state farm No. 51; 100 on No. 52; 63 on No. 53; and 18 on No. 54. In 1988, a total of 150 cases were recorded: 34 on No. 51; 22 on No. 52; 45 on No. 53; 49 on No. 54.

Analysis of the distribution of the infected individuals in 1988 indicates that most of them were concentrated in the heart of the developed tract, i.e., in the area of the colonies that had existed in the oasis area over the course of the entire epizootic season. Of the 14 sectors where great gerbils were found, five were studies, and 26 isolates of leishmania were extracted and studied. On four of the sectors, *L. major* (12 isolates) was found among the isolates. At the same time, in the area adjacent to the desert, i.e., in the area of fall colonization of great gerbils, only 11 humans contracted ZCL (all in the same family, in fact). From the great gerbils who had colonized in the fall, 12 isolates were taken, and of them, only one was identified as *L. major*, whereas the rest belonged to the species *L. turanica* and *L. gerbilli*, which are nonpathogenic to humans.

Discussion of results. In the southern USSR, the geographic ranges of the three species of leishmania are sympatric, and the epizootics of leishmaniasis among the great gerbils are caused by species of leishmania that are pathogenic to humans and nonpathogenic to humans.

Analysis of materials collected in the period 1975-1988 in the area of the second phase of irrigation and development of the Karshi Steppe makes it possible to conclude that there is a close link between epidemic activation of a natural focus, on the one hand, and the features of development of epizootics among great gerbils and the species composition of the vectors, on the other. In turn, the

conditions of development of the epizootic of leishmaniasis and the species composition of the vectors are determined, to a large degree, by the features of the water-and-temperature conditions of the soil, which affect the microclimate of the burrows of those rodents.^{4,6} Based on that factor, an area serving as a natural focus for ZCL can be divided into sectors with hyperthermal conditions in the burrows (flat deserts, sectors on watersheds of foothill deserts) and sectors with mesothermal conditions (river valleys; oases; flat, foothill sectors along arroyos).

In the sectors with hyperthermal soil conditions, the microclimate of the burrows of the great gerbil satisfies the ecological requirements for the development of sand flies of the subgenus *Paraphlebotomus*. Epizootics among great gerbils, even when there are several species of leishmania, develop along the lines of the epidemically safe type: over the extent of the entire transmission season (April, May-September-October), *L. turanica*, which is not pathogenic to humans, is dominant.

In sectors with mesothermal conditions in the burrows of the great gerbil, a microclimate forms that is more appropriate in terms of the ecological requirements for the development of *P. papatasi*, and its population, especially in certain years, can grow to a high level. In such sectors, epizootics among great gerbils acquire a two-phase nature. Over the course of the first, preepidemic phase—from May (sometimes April) to July (or the beginning of August)—despite the intensive development of epizootics and the presence of *P. papatasi*, people are not infected or they are only very seldom infected, because in the species complex of the leishmania, they dominate and the epizootics develop as a result of leishmania species that are not pathogenic to humans. Infection of humans takes place, as a rule, from July through September, when the epizootic moves into an epidemically dangerous phase. By that time, among infected great gerbils the percentage of the species pathogenic to humans in the species complex increases considerably.

The epidemically dangerous state of the natural focus is unstable, and over the winter, it returns to the initial, epidemically safe state. Even in oasis settlements of the great gerbil, each new season of transmission of the pathogen begins with the epidemically safe phase. Years with epidemically dangerous development of epizootics can alternate with years with epidemically safe development, when the epizootics do not move into the second, epidemically dangerous phase. By the same token, periods in which ZCL morbidity rises alternate with periods in which morbidity declines to a few cases or to the total absence of cases. Analysis of the perennial ZCL morbidity rate indicates that rises in morbidity are noted roughly every 5-7 years and can last for two or three years in a row.

When desert areas are irrigated, the level of ground water rises,^{7,9} which in turn has an effect on the microclimatic conditions of the burrows of the great gerbil. Our research confirms that in such conditions, an inversion takes place in the species composition of the vectors; *P. papatasi* — an epidemically significant vector—becomes dominant, and

its population grows several-fold. In such sectors, epizootics acquire an absolutely two-phase nature. Observations have shown that, on state farms Nos. 51-54, such changes can occur very rapidly, over the course of even just one epizootic season, and not over a 2-3 year period, as people formerly thought.

In areas of oases, the high risk of infection to people is created not only by small island settlements of the great gerbil, but also by solitary colonies, including those settled by just a few animals. The gerbils of one colony in that case could serve as a source of infection for 5-10 people.

In certain years, elevated population levels of vectors and the development of epizootics in two phases are possible in desert areas, too. The development of epizootics in the desert area in 1987-1988 was of the two-phase type. But the negligible number of people who contracted ZCL on the state farms Nos. 51-54 in the area of the fall colonization by great gerbils from the desert indicates that, apparently, not only is the transition of the epizootic to the epidemically dangerous phase important, but so too is the buildup in the epizootic's second phase of development of a given level of the pathogenic species *L. major*. Our data indicate that the level of *L. major* must be at least 50 percent.

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Identification of Foci of Opisthorchiasis in Belorussia

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Gorbatkova, S. K. Kvachenyuk, Ya. I. Kolesinskaya, T. N. Lysenko, Belorussian Scientific Research Institute of Epidemiology and Microbiology, BSSR Ministry of Health, Minsk; UDC 616.995.122-036.21-078(476)]

[Text] At present, the problem of opisthorchiasis has not only not lessened in significance, but has even become more acute.^{1-3,7,8,10,14}

Despite the broad extent of that helminthiasis in the republics bordering Belorussia (RSFSR, UkSSR, the Baltics, etc.), the situation with opisthorchiasis in the republic has yet to be studied.¹¹⁻¹³

In Belorussia from 1948 through 1959, only sporadic cases of opisthorchiasis were recorded.⁹ According to the data of the republic health-epidemiology station, over the period of 1969-1985, a total of 81 cases of that invasion were recorded in Belorussia, and 88 percent of them were regarded to have been brought in. The largest number of cases was recorded in Gomel Oblast (29), and after that was Mogilev Oblast (13), Vitebsk Oblast (6), Brest Oblast (2), and Grodno Oblast (1). In the 1970's, V. Ya. Linnik,^{4,5} studying the distribution of opisthorchiasis among animals, established that the basins of the Pripyat, Dnepr, Berezina, and Zapadnaya Dvina were at risk of that invasion. Large natural foci of opisthorchiasis were noted along the middle course of the rivers (the cities of Pinsk, Zhlobin, Rechitsa).⁶

In 1986, our institute, along with the Belorussian Scientific Research Institute of Experimental Veterinary and the Ye. I. Martsinovskiy Institute of Medical Parasitology and Tropical Medicine, began a broad range of research in the current situation with regard to opisthorchiasis in the Brest and Gomel oblasts of Belorussia. Those oblasts were selected because the large rivers of the Dnepr and Pripyat, with their tributaries, flow inside their borders and originate in UkSSR, where foci of opisthorchiasis have been recorded.

In the Belorussian SSR, a large number of natural communicating water reservoirs are altered, and they contain abundant vegetation and animal feed for fish. The Dnepr-Burgsk Canal connects the Pripyat with the Mukhovets River, and it connects the Bug Basin and the Ogini Canal with the Shchara River (a tributary of the Neman), which forced us to do research in Grodno Oblast also.

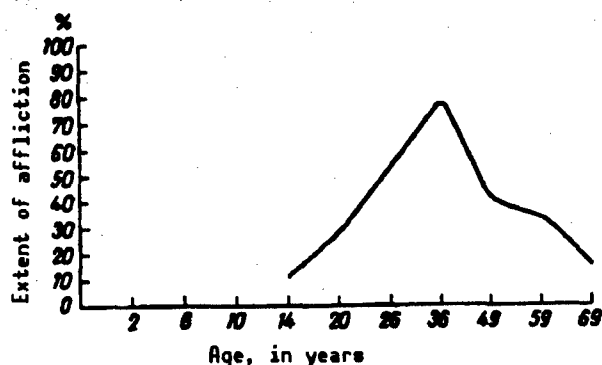
Our objective included studying the degree to which the population of those oblasts is afflicted with opisthorchiasis and clarifying the range of that helminthiasis among domestic animals, fish, and mollusks—the intermediate hosts of opisthorchis.

Areas were chosen that were located in various regional-geographic subzones (broad-leaf/pine forests and white-beech/oak/dark coniferous forests). Sectors of permanent helminthological, malacological, and ichthyological research were chosen at sites at which tributaries flowed into main rivers, at a radius of up to 5 km with the center in their confluence.

The presence of immense floodplains containing a multitude of oxbows and shallow lakes creates good conditions for fish and for the water part of the biological cycle of *Opisthorchis felineus*.

In the basins of the Pripyat, Dnepr, and Neman, the investigation was conducted on sections of the rivers and in population centers on their banks, primarily rural, with private ownership. The reservoirs are replete with fish, and most of the families have motorboats, which fosters amateur fishing.

A total of 4,007 residents of the populations centers of six rayons of the Brest, Grodno, and Gomel oblasts were studied. The contingents were selected by means of random sample. High levels of affliction were established in Zhlobinskiy Rayon of Gomel Oblast. For example, in the settlement of Streshin, opisthorchiasis was identified in 12.0 \pm 1.4 percent of the residents (Table 1), with the intensity of invasion averaging 60 opisthorchis eggs in 1 gram of fecal matter. In the middle course of the Pripyat and Neman, the extent of affliction was considerably lower and fluctuated from 1.8 \pm 0.8 percent (settlement of Namokrovo) to 4.6 \pm 2.0 percent (settlement of Kochanovichi), with an intensity of less than five eggs per gram of fecal matter. In addition to that, other types of invasion were found (trichocephaliasis, ascariasis, hymenolepiasis). As for opisthorchiasis affliction with a rate of invasion



Extent of Affliction With Opisthorchiasis Among Different Age Groups of the Population

averaging higher than 1 percent among various age groups in the populations centers, the first cases of invasion, as can be seen from the figure, are noted in the age group of 14-16. The extent of affliction increases with age, reaching a maximum (70-80 percent) in individuals 25-50 years old. A decline in the extent of affliction is noted in the more senior age groups. No differences were ascertained in extent of affliction among the population that were a function of sex or occupation.

Table 1. Incidence of Opisthorchiasis Among Population and Domesticated Cats of Three Oblasts of Belorussian SSR

| Regional-geographic subzone | River | Population center | Population | | | Domesticated cats | | |
|--|---------|-------------------|------------|----------|----------------|-------------------|----------|-----------------|
| | | | Total | Invaded | | Total | Invaded | |
| | | | | Absolute | M \pm m, % | | Absolute | M \pm m, % |
| Broad-leaf/pine forests (subzone of white-beech/oak woods) | Pripyat | Namokrovo | 220 | 4 | 1.81 \pm 0.8 | 12 | 7 | 58.3 \pm 14.2 |
| | Pripyat | Stakhovo | 417 | 12 | 2.9 \pm 0.8 | 13 | 7 | 53.8 \pm 13.8 |
| | Pripyat | Kochanovichi | 107 | 5 | 4.6 \pm 2.0 | 15 | 9 | 60.0 \pm 12.6 |
| | Smerd | Lakhva | 233 | 8 | 3.42 \pm 1.1 | 16 | 11 | 68.7 \pm 11.6 |
| | Yaselda | Zaozerye | 294 | 7 | 2.39 \pm 0.8 | — | — | — |
| | Dobysna | Gorbachevka | 75 | 2 | 2.6 \pm 1.8 | 23 | 10 | 43.4 \pm 10.3 |
| | Dnepr | Streshin | 515 | 62 | 12.0 \pm 1.4 | 14 | 13 | 92.8 \pm 18.6 |
| White-beech/oak/dark coniferous forests | Goryn | Berezhnoye | 696 | 0 | 0 | — | — | — |
| | Neman | Korelichi | 500 | 15 | 3.0 \pm 0.7 | 8 | 0 | 0 |
| | Neman | Demyanovichi | 560 | 20 | 3.5 \pm 0.7 | — | — | — |
| | Shchara | Koroli | 390 | 0 | 0 | — | — | — |

Note: "0" means "not found," and "—" means "not studied."

Surveys of residents showed that infection with opisthorchiasis takes place mainly through the ingestion of inadequately processed fish from local reservoirs.

The circulation of the opisthorchiasis pathogen is aided by cats primarily from homes whose family members do a lot of fishing. Pointing to that is the high rate of invasion

among cats, which varies from 68.7+/-11.6 percent (Brest Oblast) to 92.8 percent (Gomel Oblast). The intensity of invasion in most of the cats was negligible (7-21 helminths), and only in old animals belonging to fishermen did it reach 250. The highest infection rate in cats was observed in the population centers of the oblasts of Brest (villages of Namokrovo, Lakhva, and Kochanovich) and Gomel (villages of Gorbachevka and Streshin), where fishing crews work.

According to our data (Fig. 2), the rate of invasion varied among the various types of fish from different reservoirs. In all, 800 fish from the carp family were studied (id, bream, roach, bleak). Larvae that are morphologically similar to the metacercariae of opisthorchis were found in the id from the Pripyat, Smerd, Dobysna, and Dnepr; in the bream from the Pripyat; in the roach from the Pripyat, Smerd, Yaselda, Dobysna, and Dnepr; and in the bleak from all those rivers, except the Yaselda.

Rate of Invasion of Fish and Mollusks by Larvae of Opisthorchis in Belorussian SSR (% +/- m)

| Regional-geographic subzone | River | Carp | | | | | | | | Mollusks | |
|---|---------|------|--------------|-------|-------------|-------|--------------|-------|-------------|----------|--------------|
| | | Id | | Bream | | Roach | | Bleak | | a | b |
| | | a | b | a | b | a | b | a | b | | |
| Broad-leaf/pine forests (white-beech/oak woods) | Pripyat | 53 | 46.6 +/- 9.4 | 54 | 5.2 +/- 3.0 | 120 | 12.5 +/- 5.2 | 183 | 4.4 +/- 2.4 | 900 | 1.8 +/- 0.5 |
| | Smerd | 47 | 25.1 +/- 6.3 | — | — | 89 | 10.5 +/- 3.2 | 30 | 4.7 +/- 3.8 | 15 | 0 |
| | Yaselda | — | — | — | — | 30 | 3.6 +/- 3.3 | — | — | 190 | 0.7 +/- 0.6 |
| | Goryn | — | — | — | — | — | — | — | — | 100 | 0 |
| | Dobysna | 28 | 40.0 +/- 9.2 | — | — | 21 | 7.6 +/- 6.7 | 19 | 4.0 +/- 2.8 | 268 | 0.8 +/- 0.5 |
| White-beech/oak/dark conifer forests | Dnepr | 22 | 28.5 +/- 9.5 | — | — | 39 | 9.3 +/- 4.6 | 31 | 3.2 +/- 3.1 | 87 | 1.15 +/- 1.1 |
| | Neman | — | — | 34 | 0 | — | — | — | — | 290 | 0 |
| | Shchara | — | — | — | — | — | — | — | — | — | — |

Note: "0" represents "not found"; "—" represents "not studied"; "a" represents "studied"; "b" represents "quantity of invaded (M +/- m, %)"

A total of 1,850 mollusk specimens of the genus *Codiella* were studied, and the rate of invasion varied from 0.7 percent to 1.8 percent (in the basins of the Pripyat and Dnepr). No invasion among mollusks was found in the Neman basin.

The studies that were conducted showed that opisthorchiasis in southern Belorussia is distributed very unevenly. For example, the highest rate of invasion among the population is noted in the Dnepr basin (12.06 percent), and the lowest, in the Pripyat and Neman basins (1.8 percent and 3.5 percent, respectively).

The unevenness of the distribution of opisthorchiasis is due to a complex of social conditions and natural factors. In that regard, it is instructive that the extent of affliction among the population in the basins of the Pripyat, Neman, and Dnepr dropped as one moved upriver. In the other river basins, the extent of affliction was virtually uniform throughout each basin.

It was established that extent of affliction with opisthorchiasis among the final hosts (humans and cats) tends to rise as one goes from sectors of southwestern rayons

(Pripyat) to eastern (Dnepr) rayons of the Dnepr basin. That is because only 4.6 percent of residents in the southwestern rayons fish, whereas as many as 20 percent in the eastern rayons fish. It should be added that because of social features of the population of the Brest and Grodno oblasts, fish are not the No. 1 food in the diets in those oblasts.

The unevenness of the distribution of opisthorchiasis in Belorussia can be considered to be largely due to social conditions. For example, in Gomel Oblast (the Dnepr basin), where the highest extent of affliction with opisthorchiasis among the population is noted, more than 20 percent of the residents surveyed eat raw or lightly salted fish of two species—roach and bleak. In other basins (Pripyat and Neman), most of those surveyed indicated that they rarely eat fish, because fish are hard to get.

Natural factors also have an effect on the distribution of opisthorchiasis. It is instructive in that regard that among the areas with conditions that are more conducive to the existence of foci of opisthorchiasis is the Polesye Lowland, where we find the greatest number of reservoirs favorable to mollusks, which are the first intermediate hosts.

In evaluating the situation with regard to opisthorchiasis in the areas we studied, one can note that the south of Belorussia generally has the entire complex of ecological conditions that make possible the full cycle of development of the parasite. That should be kept in mind when planning is being done and when opisthorchiasis-control measures are being conducted.

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Evaluating the Situation With Regard to Opisthorchiasis in the Area of the Irtysh-Karaganda Canal

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[Article by Ye. G. Sidorova, Yu. V. Belyakova, D. Sh. Kukashev, Institute of Zoology, KaSSR Academy of Sciences, Alma-Ata; UDC 576.895.122]

[Text] The interest shown by medical professionals and biologists toward the canal located in the northeastern part of Kazakhstan is quite natural. Nearly 200 km of its length runs through the area of the former Shiderty focus of opisthorchiasis,² which was "suppressed" when the canal was being built.³

The possibility of the revival of the focus became quite real as a result of the entry of fish from the Irtysh into the canal with pumped water, the intensive stocking of reservoirs, the rapid establishment of fauna of hydrobionts in those reservoirs, and the presence of state farms right next to the canal. For that reason, all the medical and biological research after the canal was put into operation were aimed at studying the situation and factors upon which the revival of the Shiderty focus are dependent.

The first studies in that regard were performed in June and July of 1982.⁴ From six reservoirs, 227 specimens of commercial-size fish were studied. Larvae of *Opisthorchis felineus* were found in only the dace (*Leuciscus leuciscus*) taken from the first reservoir. Typical of the results of the studies conducted was that somatic metacercariae and other species of trematodes were encountered extremely rarely. *Bythnia inflata* and *B. troscheli* mollusks [bitinii] were found in most of the reservoirs (2-958 specimens per sq. m.), and neither was found to be invaded.

The results of the studies led to the conclusion that the Shiderty focus of opisthorchiasis had recovered.

Researchers studying the distribution of opisthorchiasis among the population came to a different conclusion.^{1,6} After finding individuals with opisthorchiasis (2-3.7 percent of the number examined) on three state farms near the canal, they write convincingly of cases of local infection. Confirmation of that was a report on opisthorchiasis metacercariae found in two roaches (*Rutilus rutilus lacustris*—1 or 2 of each) taken from reservoirs Nos. 1, 7, and 8 and in 43 percent of the dace from reservoir No. 11.⁷ Somewhat later, after the presence of a large population of bitinii in several reservoirs was ascertained, it was concluded that the Shiderty focus of opisthorchiasis was still functioning.⁸

The survey of the notions about the situation in the area of the canal was reflected in the decision of the Pavlodar Oblast Executive Committee (1988), which was adopted at the recommendation of the veterinary and health-epidemiological services, to ban the sale of fresh fish caught in the canal's reservoirs.

Any decision dictated by a concern for the health of the population can only be welcomed if the proposed measures are sound and do not have negative consequences. But in this case, there was not enough evidence, and the negative consequences consisted in the fact that the population of the Pavlodar and Karaganda oblasts were deprived of fresh fish. Moreover, the fish processing plant suffered additional losses stemming from the mandatory reprocessing of "conditionally acceptable" fish, which prompted it to turn to the KaSSR Academy of Sciences Institute of Zoology for assistance in resolving the situation.

Materials and methods. In order to determine the current situation with regard to opisthorchiasis in the area of the canal, nine of 11 reservoirs were studied, as was one of the preserved sections of the Shiderty River in the middle part of the channel of that river at two points outside the influence of the canal (20 km and 30 km above reservoir No. 11) and at two points on the Olenty River. The Olenty River runs parallel to the Shiderty 30-40 km west of it. In each of the reservoirs, mollusks were collected with standard hydrobiological techniques, and their populations were ascertained per unit of area for various biotopes. The invasion rate by parthenitas was identified with microscopy of the mollusks with condensers [v kompressorii].

In order to identify the presence in the fish of opisthorchiasis metacercariae, all the species of the fish that were potential carriers of those larvae were studied. They were caught primarily by an expeditionary crew with set nets, drag nets, and poles. ON two reservoirs, fish from commercial catches were used. A sample for the study was to be 50-100 fish. But that figure was not always reached, because of the extremely uneven distribution of certain species of fish in the reservoirs. In all, 929 sexually mature fish were studied, including roach (*R. rutilus lacustris*, 428), bream (*Abramis brama orientalis*, 228), dace (*L. leuciscus baicalensis*, 114), gudgeon (*Gobio gobio*, 82), tench (*Tinca tinca*, 38), minnow (*Phoxinus* sp., 27), id (*Leuciscus idus*, 6), and loach (*Noemacheilus* sp., 5). Of them, 212 were taken from rivers (six roach, nine tench, 81 dace, two id, and all the gudgeon, minnow, and loach), and the rest came from reservoirs.

The fish were studied with the standard technique—microscopy with an MBS condenser [kompressoriiye] from the subcutaneous layer of muscle. Biological assay was done on golden hamsters.

At the same time, visual assessment was made of the possible participation of populations centers on the banks in the pollution of reservoirs of the canal as the invasion source. The extent of the development of commercial and amateur fishing was determined.

Results and discussion. The hydrobiological collections made it possible to identify 13 species of mollusks, including those from the *Codiella* (*Bithynia*) genus—*C. inflata* and *C. troscheli*. In reservoir No. 1, those species were found in only one spot—a small rocky island of detritus. The populations of those species reached 800 per sq. m. The current brood and specimens 1-3 years old predominated. Those mollusks were found in the usual

biotopes in reservoirs Nos. 7 (5-10 per sq. m) and 11 (25-30 per sq. m.). The *Codiella* population in the Shiderty River was three- to fourfold larger. Their invasion by opisthorchiasis parthenitas was detected in only the old Shiderty channel that is preserved between reservoirs Nos. 6 and 7 and that is fed by drainage waters from the canal running right next to it.

The fauna of somatic metacercariae in the fish from the reservoirs was extremely scant. Only in the reservoirs Nos. 4 and 7 were isolated *Strigeidae* gen. sp. larvae found. The fauna was extremely varied in the rivers. In the Olenty River, opisthorchiasis metacercariae were found in the gudgeon (1.2 percent) and the minnow (4 percent). The dace in that river had *Metorchis albidus*, *Strigeidae*, and *Syathocotylidae* larvae.

Considerably higher was the extent of infection of fish in the Shiderty south of reservoir No. 11. *O. felineus* larvae were found in 33 percent of tench, 84 percent of dace, and in both the id. Noteworthy is the extremely high intensity of invasion in that segment of the river. In the dace, it reached 500, and in the id, 1000.

The scale and complexity of the studies and the fact that they encompassed not only most of the reservoirs along the canal, but also the small rivers located nearby, made it possible to define the situation with regard to opisthorchiasis that has come about in the area of the canal during its operation. The canal itself and the reservoirs located along its length should be regarded at present as favorable for the invasion under study.

Isolated cases of the detection of invaded fish in the first reservoirs can be explained by the entry of those fish into the reservoirs from the Irtysh focus. Reservoir No. 11 should be regarded as not in the canal system, but in the system of the upper section of the Shiderty River. It performs the role of reserve reservoir, collecting the entire flow of that river. The water from it can either be sent into the canal and pumped toward Karaganda or sent into the old channel of the Shiderty. The probability of the circulation in it of the opisthorchiasis pathogen is no higher than in the reservoirs along the canal. But the high level of invasion of the fish in it is explained not by local contamination, but by the fact that contaminated fish from the Shiderty "jump" into it. The Shiderty, in the segment outside the influence of the affluent by reservoir No. 11, has largely remained the same as before the construction of the canal. A slow current, alternating deep pools and shallows, thick undergrowths of reeds, and the presence of water voles (*Arvicola terrestris*) create optimum conditions for the circulation of the opisthorchiasis pathogen. Confirming that is the growth of the extent of infection of fish as one moves away from the reservoir. Indirect confirmation is the extent of invasion of the population. For example, on the Shidertinskiy State Farm, located opposite reservoir No. 11, opisthorchiasis was recorded in 1.6 percent of the residents examined; on the Stepnoy State Farm, located right on the river, 30 km from the reservoir, opisthorchiasis was found in 6.3 percent.

Analysis of the current situation in the area of the canal makes it possible to assert that all cases of local infection of the population and domesticated animals are associated with fish from the Shiderty River above reservoir No. 11 and from the preserved segments of the river in the vicinity of reservoirs Nos. 4-10. A graphic illustration of that is the analysis of the possible source of infection of the population of the Stepnoy State Farm in Pavlodar Oblast, which is 3-4 km from the canal and the nearest reservoir, on the banks of the old channel of the Shiderty River. Judging from all the information, the water level in the preserved segment of the river is very stable and is maintained by drainage water and the canal. The stability of the water conditions results in the abundance of various hydrobionts. The *Codiella* population reaches 600 per sq. m. here. Their opisthorchiasis parthenitas contamination levels (3.2 percent) merit special attention. Here, there is clearly functioning a local focus of opisthorchiasis that invades the local residents.

In the epidemiological analysis of the canal area, the upper segment of the Shiderty (outside the canal itself) is clearly inadequately assessed. According to local residents and fish inspection workers, that small river attracts a good many fishermen, primarily children from nearby settlements, trying to catch dace, roach, and sometimes tench with fishing poles. Such fish cannot be caught with poles on the reservoirs, and the use of nets is kept down by the danger of encountering fish inspectors.

The epidemiological significance of the Olenty River is considerably less, because of the scantiness of its fish population and its remoteness from the canal. However, one cannot completely exclude the possibility of its participation in the infection of the population from the canal area, because near it there are several state farm agricultural plots that are located next to the canal.

Thus, the area of the former Shiderty focus of opisthorchiasis should at present be divided into two parts. The first consists of the upper segment (plus conditionally reservoir No. 11), which is active as an opisthorchiasis focus. The second is the canal and all the other reservoirs. On that part, the focus has been suppressed, but there is a potential for its revival.

On the second part of the focus, the segments of the river untouched by the building of the canal merit special attention. One can assume that local foci similar to the focus located in the vicinity of the Stepnoy State Farm exist in other places, too.

The study results presented here have made it possible to substantiate the removal of the restraints on the sale of fresh fish from the canal.

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Tickborne Encephalitis

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[Article by S. P. Chunikhin, Institute of Poliomyelitis and Viral Encephalitis, USSR Academy of Medical Sciences, Moscow; UDC 616.831-002-022.7:578.833.26]-022.39]

[Text] The beginning of the study of tickborne encephalitis (TBE) was laid by the work of Ye. N. Pavlovskiy, M. P. Chumakov, A. A. Zilber, Ye. N. Levkovich, V. D. Solovyev, and other participants of the first expeditions (1937-1938) of the USSR People's Commissariat of Health in Kharbarovskiy Kray and the Maritime Kray.

As early as in the first few years of study of the new infection, the features of the clinic and epidemiology of TBE were identified. It was shown experimentally that the source of the TBE virus for ixodid ticks was wild vertebrate animals in the period of viremia. Ixodid ticks transmit the virus to animals or to man when they suck blood. Moreover, among the ticks, the virus is transmitted in a transphase fashion (from larvae to nymphs and from nymphs to adult ticks) and in a transvarial fashion (from infected female through the eggs to larvae).

According to the recollections of Ye. N. Pavlovskiy, the observations in the TBE foci in the Khabarovsk and Maritime krays served as an impetus for the creation by him of the science on the natural foci of human diseases. Thus was established the scientific approach to the problem of anthroponoses and their place among infectious zoonoses.

Over the years since the discovery of TBE, the role of various groups of vertebrates and various species of ixodid ticks in the circulation of the virus has been ascertained, the geographic range of the virus has been established, the methods associated with the clinical and laboratory diagnostics have been developed, the regional features of the clinical course and epidemiology have been identified, vaccines have been produced and methods of specific

vaccine and serum prevention of infection have been developed, and a method of nonspecific prevention of TBE consisting in the use of acaricides to suppress the population of ixodid ticks has been proposed and successfully tested.

Despite the considerable successes in the study of the nature of the infection and in the development of various methods to prevent it, TBE continues to be one of the most important problems of USSR health care. Natural foci of TBE are very widespread in the forest and forest-steppe zone of Europe and Asia. In the Soviet Union, TBE is established in Russia, Azerbaijan, Belorussia, Kazakhstan, Kirghiziya, Latvia, Lithuania, Moldavia, the Ukraine, Uzbekistan, and Estonia. Outside the Soviet Union, TBE foci are found in Finland, Poland, Czechoslovakia, Hungary, Austria, Bulgaria, Yugoslavia, Rumania, Albania, Germany, Sweden, Norway, Ireland, Greece, France, Italy, Mongolia, and China.

The natural TBE foci differ in the various parts of its nosogeographic range in terms of degree of epizootic activity: from a low level of activity in the forest-steppe regions to a high level in a number of forest regions. The epidemic activity of TBE foci depends not only on the degree of their epizootic activity, but also on a number of social factors, first among them being the population density in endemic areas and the nature of the population's business and economic activity.

The TBE virus circulates in natural foci of infection along the chain of ixodid ticks/wild vertebrate animals/ixodid ticks.

Contamination with the TBE virus is established among 14 species of ixodid ticks: *Ixodes persulcatus*, *I. ricinus*, *I. pavlovskiyi*, *I. trianguliceps*, *I. lividus*, *I. gexagonus*, *I. gibbosus*, *Haemaphysalis concinna*, *H. japonica*, *H. inermis*, *Dermacentor marginatus*, *D. silvarum*, *D. reticulatus*, *D. nuttalli*. Despite the considerable number of species of ixodid ticks from which the TBE virus has been isolated, real epidemic significance attaches to only two species: *I. persulcatus* in the Asian regions and a number of regions of the European part of the nosogeographic range of the infection, and *I. ricinus* in the European part.

Until very recently, the natural donors of the TBE virus were thought to be vertebrate animals in whom viremia could exceed the threshold level of infectiousness of 2.7-3.0 log LD_{50/0.03 ml}.

Rather extensive experimental materials on viremia associated with TBE in small, medium, and large mammals, birds, reptiles, and amphibians have made it possible to conclude that the most frequent donors of the virus for ticks (in the larval and nymphal stages of development) are wild rodents. The role of their various species in the process of circulation of the virus is quite varied. For example, species that amplify (accelerators) the process of viral circulation in natural foci and species that suppress it (retarders) have been delineated. The group of accelerator-species includes *Microtus* and *Clethrionomys rufocanus* vegetation-eating voles, and the group of retarder-species

includes certain seed-eating species of forest mice (*Apodemus silvaticus*, *A. peninsulae*), the common shrew (*Sorex araneus*), and the chipmunk (*Eutamias sibiricus*). Such a widespread species as the bank vole (*Clethrionomys glareolus*) behaves as a suppressor of the viral circulation process in some (European) TBE foci and as an amplifier of it in others (Asian).

Quite recently, adjustments have had to be made in the TBE viral circulation scheme based on levels of viral infectiousness for ixodid ticks as a function of levels of viremia. The possibility of exchange of the TBE virus between donor-ticks and recipient-ticks when both are feeding on animals with a "subthreshold" level of viremia has been proven in experiment. That exchange has been shown to take place when blood is sucked from the same focus of inflammation on the skin of the vertebrate by infected ticks and uninfected ticks. The new route of transmission of the virus has been called transptial (from the Greek *ptialon*, saliva). One can be sure that transptial transmission of the TBE virus—as with, by the way, other viruses transmissible by ticks—also takes place in natural foci, but the scale of the phenomenon and its role in the dynamics of natural populations of viruses still needs to be studied.

As we know, the most frequent means of infection of humans with the TBE virus is transmissive, i.e., associated with sucking by infected ticks—adult or nymphal. For a long time, it was felt that the main role in the transmission of the TBE virus to humans belonged to females, which required a long time to become saturated with blood. It was also presumed that the process of transmission takes place after several hours of sucking, when the tick's salivary glands begin to become active. Quite recently, it was proven that the TBE virus begins to be removed with the saliva in the very first minutes after the tick begins sucking. And that is when the TBE infection occurs. Especial significance for the transmission of the virus from ticks to vertebrates attaches to the so-called cement fraction of the saliva, the purpose of which is to secure the hypostome in the skin covering of the host. Removal of the tick even 30-60 minutes after it has begun sucking does not affect the successful transmission of the virus, because by that time the "cement" cone is already forming, and the dose of the virus in it often exceeds the dose of the virus in the entire body of the tick.

As we know, the males of the main vectors of TBE virus—*I. persulcatus* and *I. ricinus*—suck blood for a short time and transmit a small amount of virus. We also know, however, that they can suck several times in a short interval of time, thereby increasing the possibility of TBE infection.

The discovery of the rapid transmission of the TBE virus by the ixodid ticks (in the first few minutes of sucking) is very important for explaining the lengthy existence of natural foci of infection. As we know, many mouselike rodents—which feed on the larvae and nymphs of ixodid ticks—successfully rid themselves of ticks that get on them, preventing 50-80 percent of the ticks to feed completely. The mechanical removal of the ticks by the hosts is

not the only factor that prevent their satiation. There is much data in the literature indicating that factors of cellular and humoral immunity often prevent the successful saturation with the blood of the host. It has also been shown that immunity to ticks among vertebrates can serve as an obstacle to the successful dissemination of the virus. Since that immunity develops in the host the more the ticks saturate themselves with the blood, it is important for the tick to reach the target-organs early in order for the virus to reproduce successfully in the body of the vertebrate. Thus, removal of the virus with the saliva in the very first few minutes after the tick has attached to the host is an evolutionary expedient for the circulation of the virus. Until recently, it was thought that that direction of natural selection toward acceleration of transmission was typical of only viruses carried by arthropods rapidly saturating themselves with blood such as mosquitoes, sand flies, and biting midges.

It was shown recently that dissemination of the TBE virus via the male ixodid ticks is done not only via transmissive transfer of the virus, but also via sexual transmission. The TBE virus is found in generative cells of the males and in their saliva enveloping the spermatophore.

Electron microscopy of the sexual system of ticks infected with this virus has found a multitude of mature viral particles in the spermatocytes and spermatids. It has been shown that the TBE virus penetrates generative cells of male ixodid ticks in the early stages of spermatogenesis. Replication and accumulation of the virus run parallel with the process of the transformation of generative cells. Such a coupling of viral reproduction and spermatogenesis indicates the considerable evolutionary history of bonds of that virus and the generative system of male ixodids. Sexual transmission of TBE in ixodid ticks also supports the transvarial transmission; the virus is found in 10.5 percent of first-generation larvae.

Although the sexual transmission of TBE virus has been proven in laboratory experiment and, undoubtedly, takes place in natural foci of infection, the scale of the phenomenon and its role in the dynamics of natural populations of the virus remained unstudied. Nevertheless, the fact that the sexual route of transmission exists in the presence of transphase and transvarial transmission presumes the possibility of the circulation of the TBE virus without the participation of vertebrates.

The prevention of TBE includes the following complex of measures: vaccine and serum prophylaxis, tick-control treatment of foci, health education among the population, and individual measures to control ticks.

At present, vaccination against TBE is done with inactivated cultured vaccine in the context of a complicated vaccination schedule that includes an initial course (four injections at intervals of 7-10 days, 20-30 days, and 4-6 months) and three annual booster vaccinations. The full course of shots leads to a 6- to 9-fold reduction in morbidity among those who receive it. The effectiveness lasts

at that level for five years. Individuals who live permanently in endemic areas receive booster revaccinations every four years.

Inactivated, cultured, purified, and concentrated vaccine is more effective, but the tiny scale of its production precludes broad use.

The problem of live TBE vaccines at present is being solved in the context of a determination of the general patterns of variability of attenuated strains, a study of mechanisms of immunogenesis, and the development of new criteria for monitoring specific safety and long-term consequences of vaccination.

Serum prevention of TBE with human immunoglobulin is used if an individual has found ticks on his body in the foci or if an individual has become infected with TBE in the laboratory. The method demonstrates a high level of effectiveness if used in the first two days after infection.

Tick-control treatment of TBE foci with acaricides, as a method of nonspecific prevention of the infection, remains one of the leading methods of prophylaxis. Its epidemiological effectiveness has been proven more than once in various kinds of TBE foci. The perennial epidemiological effect is achieved with the use of 10 percent DDT dust. Recently, that preparation was banned, and an energetic search is needed to find agents to replace the DDT.

This brief article about TBE has consciously avoided a whole host of problems that are illuminated in detail in the monographs listed below.

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Transmission of Tickborne Encephalitis With Cow's Milk

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[Text] The alimentary route of TBE infection associated with the ingestion of raw goat's or sheep's milk has long been known of.¹⁰

In 1958, in the settlement of Tabo of the Ulchskiy Rayon of Khabarovsk Kray, a family group contracted TBE as a result of, presumably, the ingestion of raw cow's milk. In K. family—which consisted of the father, mother, and eight children—six individuals became ill at once, and three of them had noted ticks on their bodies. The family kept two cows, and antibodies to the TBE virus were found in the blood of one of them in a dramatically elevated titer.

That case alone did not enable anyone to say with certainty that TBE induced by the eastern antigen version of the virus can be transmitted through cow's milk, but it did point to the need for a study of such a possibility. In experiment, viremia had developed and the virus transferred to the milk in cows subcutaneously infected with the virus of [so-called] two-wave fever.³ However, "penetration" of the virus into the milk occurred only when the cow was infected with a massive dose, which, in natural conditions, does not appear to happen often. Thus, the question of the alimentary route of TBE infection associated with the ingestion of raw cow's milk required confirmation.

In the city of Bikin, in Khabarovsk Kray, over the course of a 10-day period that lasted from 19 June 1987 through 28 June, group illnesses were observed in three families: five individuals became ill—we will call them B.A.V., Z.N.F., Z-ko T.N., Z-ko L., and O.I.K. None of the

individuals had lived in the Far East for more than two years, none had received TBE vaccinations, all said they had had no contact with ticks, and all had drunk cow's milk they had bought from a woman we will call L., who had three cows.

B.A.V. became ill on 20 June 1987. When he was still alive, he was diagnosed as having serous meningitis. He died on the tenth day of his illness. The autopsy diagnosis was TBE. In the Z-ko family, three of the four family members became ill—the mother, the daughter, and the sister of the husband. The mother had drunk the raw milk on an empty stomach, the sister had ingested lactic acid products, primarily clabber made from the milk; and the daughter had both drunk the milk and ingested the clabber.

In family three, only the wife (Z.N.F.) became ill; she had drunk raw cow's milk on an empty. The husband (Z.M.V.) did not drink milk, and he remained healthy.

In two individuals (Z.N.F. and Z-ko T.N.), the illness developed acutely and was characterized by a severe course and rapid growth of motor and respiratory disorders, with clinical death and a lethal outcome.

From the brain of the corpse of Z.N.F., a strain of the TBE virus was isolated on day 13 after white mice had been initially infected. The isolate, in subsequent passes on the mice, produced a pattern of experimental TBE on days 13 and 14. On the third pass, the isolate was identified in a biological neutralization test; the neutralization index was $2.2 \log LD_{50/ml}$, and virulence was characterized as $mNc = 7.52 \log LD_{50/ml}$, $mNsc = 5.93 \log LD_{50/ml}$, and $II = 1.59 \log LD_{50/ml}$. The hemagglutination test with the strain was in the pH range of 6.3-6.6, with a maximum titer of 1:320 at pH 6.4. The titer of saccharose-acetone antigen in the complement fixation test (CFT) with the immune serum for strain 139 of the TBE virus was 1:32. The virus tested on the mice was identified also with enzyme immunoassay (EIA) in a titer of 1:160-1:320.

The results of the virological-serological testing of the individuals and the cows are given in the table. According to the data of the serological tests, a complement-fixing antigen for the TBE virus was found in the blood serum of Z.N.F., as were antibodies to the virus in CFT, hemagglutination inhibition test (HIT), and in EIA in a growing titer.

Table 1. Results of Study of Family-Group Illnesses With TBE (Alimentary Route of Transmission)

| Family | Individual | Age of subject, years | Date of onset of illness | Clinical form of illness | Milk or milk product ingested | Time of ingestion |
|--------|------------|-----------------------|--------------------------|--------------------------|-------------------------------|-------------------|
| Z-ko | T.N. | 35 | 20/6/87 | Panencephalitis | Raw milk | Empty stomach |
| | L. | 9 | 26/6/87 | Meningeal | Raw milk, clabber | Empty stomach |
| | O.I.K. | 18 | 26/6/87 | Obliterated | Clabber | Empty stomach |
| | I.M. | 36 | Healthy | Healthy | Raw milk | After eating |
| Z. | N.F. | 29 | 15/6/87 | Panencephalitis | Raw milk | Empty stomach |
| | M.V. | 34 | Healthy | Healthy | None | Did not drink |

Table 1, con't. Results of Study of Family-Group Illnesses With TBE (Alimentary Route of Transmission)

Data of virological-serological tests of humans

| CFT-antigen | | | | CFT-antibodies | | | | HIT | | | | EIA | | | |
|---------------|----|---|----|----------------|----|----|----|-----|-----|-----|-----|-----|-----|-----|---|
| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Inverse titer | | | | | | | | | | | | | | | |
| 8 | 0 | 0 | — | 0 | 8 | 16 | — | 20 | 320 | 640 | — | 160 | 160 | 320 | — |
| 4 | 4 | 0 | — | 0 | 8 | 16 | — | 40 | 320 | 160 | — | — | 160 | 160 | — |
| 8 | 4 | — | — | 16 | 32 | 16 | — | 0 | 10 | 0 | — | 0 | — | 40 | — |
| 0 | — | — | — | 0 | — | — | — | 320 | — | — | — | 160 | — | — | — |
| — | 16 | 8 | 32 | — | 0 | 0 | 16 | — | 20 | 80 | 640 | — | 80 | 80 | — |
| 0 | — | — | — | 0 | — | — | — | 0 | — | — | — | 0 | — | — | — |

Table 1, con't. Results of Study of Family-Group Illnesses With TBE (Alimentary Route of Transmission)

| Isolation of virus | Results of serological tests of cows | | |
|--------------------|--------------------------------------|----------------|----------------|
| | Age of animal | CFT-antibodies | HIT-antibodies |
| | | Inverse titer | |
| 0 | 6 | 0 | 160 |
| — | 12 | 32 | 640 |
| — | 2 | 16 | 0 |
| — | — | — | — |
| + | — | — | — |
| — | — | — | — |

Note: In the heading, the numerals 1-4 designate blood samples taken (1, upon entering hospital; 2, on days 9-10; 3, on days 14-15; 4, on days 17-19); "0" designates "not determined"; "—" designates "not tested"; "+" designates "virus isolated."

In Z-ko T.N., who died, antibodies to the TBE virus were found when the individual was still alive. In the two other family members, the illness assumed milder forms—meningeal and obliterated. In the first samples of blood taken from those individuals, the CF antigen was detected, as were antibodies in CFT, HIT, and EIA (see table).

In addition to those who had become ill, healthy members of two of the families were tested: Z-ko I.M. and Z.M.V. The tables shows that antibodies determined in HIT and EIA existed in the blood serum of Z-ko I.M., but not of Z.M.V. The presence of antibodies to the virus in the head of the family, Z-ko I.M., may be attributed to latent immunization via the alimentary route,⁶ since the family

has been living in the Far East for less than a year, Z-ko I.M. denies having noted any ticks on his body, and no signs of the illness were noted in him.

The absence of antibodies in Z.M.V., who did not become ill, is also explainable, in that he did not drink any milk and did not note any ticks on his body.

Serological testing of the cows (see table) found complement-fixing antibodies and hemagglutination inhibiting antibodies in the blood of one of the cows and complement-fixing antibodies in another (two-year-old), which indicates recent infection.

In Khabarovsk Kray, cows are often grazed far from population centers. According to the owner, her cows

grazed in the vicinity of Bikin, which is confined geographically to the Ussuriysk Valley, and ixodid ticks were removed from them. According to the data of I. V. Koneva,⁴ who collected ticks from cows in the Ussuriysk Valley, one cow can feed 47-63 ticks from May through August.

A specific feature of the anthroponotic foci of TBE is the participation of domesticated animals in the feeding of ixodid ticks. That explains the role of cows as part of the chain of viral circulation. It is not surprising that 63 percent of cows tested in the Ussuriysk Valley had antibodies to the TBE virus in the neutralization test.⁸

Thus, in Bikin, in Khabarovsk Kray, a group infection with TBE was observed: five individuals from three families who ingested milk or lactic acid products. The ingestion of clabber, rather than milk, also points to one source of the virus. For example, the TBE virus is known to be found not only in the milk of goats and sheep, but also in their lactic acid products.^{9,10} Apparently, the severity of the course and the lethal outcome of the illness in the three individuals were due to the high infecting dose of the virus entering the body with the milk, because the strain isolated from the brain of the deceased Z.N.F. was not highly virulent.

Conclusion. The materials of the clinical-epidemiological and virological-serological study of the family-group TBE illnesses enable us to clearly conclude that the illnesses were related to the ingestion of raw cow's milk and lactic acid products made from it. The materials we obtained, plus the data of the experimental testing and of the analysis of the outbreaks of TBE noted in 1958 in the settlement of Tabo, confirm the earlier mentioned idea of the presence of an alimentary route of transmission of TBE with cow's

milk and indicate the need to boil milk in TBE endemic regions in the spring-summer period.

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Determination of Replicating Activity of Recombinant Plasmids, Containing the SV40 Virus Eukaryotic Regulator Region, in Mammalian Cell Cultures

927C0511B Kiev *BIOPOLIMERY I KLETKA* in Russian Vol 7 No 5, Sep-Oct 91 (manuscript received 5 Jul 90) pp 103-107

[Article by S. M. Landau, A. v. Tikhonov, I. S. Varzanova, and L. g. Zharova; Institute of Molecular Biology and Genetics, Ukrainian SSR Academy of Sciences, Kiev; UDC 575.155:575.224.46]

[Abstract] Two of the primary tasks in gene therapy are to construct vectors and to study their biological activity (replication and expression) in mammalian cell cultures prior to their use in model experiments on animals. In this work, a method for identifying the functional activity of the SV40 virus eukaryotic regulator region incorporated into recombinant plasmids was proposed that could be applied in testing plasmids for use in gene therapy. It was shown that the studied recombinant plasmids (pHG, pKCR, and pGA293) replicated in CV1 cell cultures and subsequently incorporated the functionally active eukaryotic Western.

Cytogenetic Changes in Peripheral Leukocytes of Patients With Chernobyl-Related Radiation Injuries

937C0059A Kiev *TSITOLOGIYA I GENETIKA* in Russian Vol 25 No 4, Jul-Aug 92 (manuscript received 16 Mar 90) pp 17-21

[Article by M.A. Pilinskaya, A.M. Shemetun, M.N. Yermeyeva, D.V. Redko, V.G. Fedorenko and S.Ye. Shepelev, All-Union scientific Research Center for Radiation Medicine, USSR Academy of Medical Sciences, Kiev; UDC 576.312.32/38:612.014.482]

[Abstract] Cytogenetic examinations were performed on peripheral blood leukocytes of 51 individuals (50 males, one female) who had presented with various stages of radiation injuries as a result of participation in Chernobyl cleanup. Most of the studies were carried out nine to 12 months after exposure and showed considerable individual variability as to the percentage of cells with chromosomal abnormalities (1-38 percent) and the types of abnormalities. In the later stages dicentric and circular chromosomes were not accompanied by paired fragment in the majority of the patients, suggesting that fragmentation originated from stem cells damaged at the time of irradiation. This observation also supports the view that lymphocytes with unstable chromosomal mutations tend to be eliminated by 12 months. Late observations (38 months) indicated that

persistence of abnormalities is directly related to initial exposure and may not reflect low-level exposures. Tables 6; references 17: 7 Russian, 10 Western.

Genetics of Sunflowers Regenerated From Somatic Cell Cultures

937C0059B Kiev *TSITOLOGIYA I GENETIKA* in Russian, Vol 25 No 4, Jul-Aug 92 (manuscript received 11 Nov 90) pp 21-26

[Article by T.F. Petrova, I.P. Voronina and A.K. Gaponenko, "Bioenzhineriya" Center, "Biotekhnologiya" MNTK [expansion unknown], and Institute of General Genetics, USSR Academy of Sciences, Moscow; UDC 575.155:576.316.7]

[Abstract] Dwarf forms (16 cm) of sunflowers (*Helianthus annuus*) regenerated from 9-21 day old ovule integument of wild-type plants (110-140 cm) were subjected to cytogenetic analysis because of morphological deviations from parental variety. The regenerated plants were shown to contain $2n = 34$ chromosomes, as did the parent type. In addition, the karyotype was also identical, consisting of the following 4 chromosomal groups: I—SAT, II—M, III—SM, and IV—A,T. Tables 3; references 9: 4 Russian, 5 Western.

Introduction of RAS Oncogene Into Antibody-Producing Hybridoma

937C0061B Moscow *GEMATOLOGIYA I TRANSFUZIOLOGIYA* in Russian Vol 36 No 8, Aug 91 (manuscript received 11 Oct 90) pp 7-11

[Article by Ye.V. Belkina, Ye.I. Deryugina, N.I. Drize, N.I. Olovnikova, Ye.Yu. Sadovnikova and I.L. Chertkov, All-Union Hematological Scientific Center, USSR Ministry of Health, Moscow; UDC 616-006-092.9-02:615.277.4]-073.33]

[Abstract] Electroporation was used to introduce H-ras oncogene-bearing plasmids into hybridoma cells producing monoclonal antibodies specific for human blood group A antigen. Introduction of the oncogene into A-86/3 hybridoma cells—prepared by fusion of BALB/c mouse spleen cells with M3-X63-Ag.8.653 myeloma cells—decreased the doubling time of the transformed 1.8-fold cells. However, none of the other characteristics of the hybridoma were affected (cloning efficiency, antibody production, antibody avidity, ascitic fluid induction in BALB/c and (WR x BALB/c) F_1 mice). Accordingly, reduction of the doubling time may have some significance in large-scale hybridoma production, but in small-scale terms the value of the hybridoma as a source of monoclonal antibodies was not significantly enhanced. Figures 2; tables 6; references 13: 1 Russian, 12 Western.

Prevention of Wound Infection by Gentacycol in Gunshot Limb Fractures: In Vitro and Animal Studies

937C0067B Moscow *ORTOPEDIA, TRAVMATOLGOYA I PROTEZIROVANIYE* in Russian No 6, Jun 91 (manuscript received 13 Mar 91) pp 1-5

[Article by Yu.G. Shaposhnikov, A.I. Kaveshnikov, G.M. Kroytor, G.G. Okropiridze and S.I. Lipkin, Central Institute of Traumatology and Orthopedics, Moscow; UDC 617+001+616.7]

[Abstract] Gentacycol, a gentamicin + collagen combination, was shown to possess antimicrobial activity against both aerobic and anaerobic bacteria in disk diffusion studies. Studies on rabbits with various forms of deliberately infected bone wounds and limb fractures demonstrated that gentacycol was also an effective antibacterial under these conditions and, moreover, evidenced anti-inflammatory properties and enhanced healing and osteogenesis. Accordingly, these observations suggest that gentacycol may have clinical applications in the management of gunshot limb fractures. References 13: 8 Russian, 5 Western.

Efficacy of Fibronectin and Emoxipin in Ocular Burns

937C0067C Odessa *OFTALMOLOGICHESKIY ZHURNAL* in Russian No 3, Mar 91 (manuscript received 24 Apr 90) pp 171-173

[Article by Ye.V. Chentsova, cand. med. sci., A.A. Shvedova, dr. biol. sci., S.I. Ibadova, cand. med. sci., and Yu.A. Kapitonov, Moscow Order of the Red Banner of Labor Scientific Research Institute of Eye Diseases imeni Gelmgolts; UDC 617.7-001.17-085:612.085.1]

[Abstract] Studies on 2.5 kg chinchilla rabbits with corneal burns induced by 10 percent NaOH for 20 sec showed that

best therapeutic results were obtained with emoxipin + fibronectin combined therapy. Optimum treatment consisted of three instillations of fibronectin (500 μ /ml) and 0.2 percent emoxipin with subconjunctival injections of 0.2 percent emoxipin. Epithelialization was observed to take place in 5-7 days with gradual recovery of translucence. After 28 days corneal opacity was limited to a 5 mm area. These observations confirmed the efficacy of combining fibronectin with emoxipin, an antioxidant and a structural analog of vitamin B₆. Tables 1; references 8: 3 Russian, 5 Western.

Stable Recovery of Endogenous Insulin Production in Experimental Insulin-Dependent Diabetes

937C0067F Moscow *VOPROSY MEDITSINSKOY KHIMII* in Russian Vol 37 No 4, Jul-Aug 91 (manuscript received 22 Oct 90) pp 40-43

[Article by B.A. Kudryashov and A.M. Ulyanov, Moscow University imeni M.V. Lomonosov; UDC 616.379-008.64-092.9-02:615.366.153.939.623-02:616.379-008.64]-085.31:547.995.17]-036.8:616.379-008.66]

[Abstract] Outbred, 200-220 g male rats with alloxan (40 mg/kg; i.v.)-induced diabetes were used to test the therapeutic efficacy of heparin in promoting survival of implanted allogenic pancreatic β -cells. Heparin was chosen since it has been shown to combine with the cell destroying diabetogenic factor (DBF) in vitro. The experimental group was pretreated intravenously with 500 IU/kg of heparin five minutes before implantation of the cell suspension into the rectus abdominis muscles. The animals were then placed on a b.i.d. maintenance schedule of heparin (250-300 IU/kg) for three months. Monitoring of the experimental rats for 14 months showed good sugar control with plasma insulin levels on the order of 17 μ IU/ml, indicating graft survival and function. After withdrawal of heparin these animals remained free of DBF. In untreated animals insulin production ceased after 10 days to three months due to β -cell destruction by DBF. Figures 2; tables 1; references 28: 22 Russian, 6 Western.

Effect of Stress Factors on the Activity of Carboxypeptidase H on Rat Brain Regions

927C0489A Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian Vol 64 No 2, Mar-Apr 92 (manuscript received 30 Sep 91) pp 45-49

[Article by A. N. Vernigora, M. T. Gengin, and V. V. Makarova; Penza Pedagogical Institute; UDC 616-092.9+577.152.341]

[Abstract] It has been shown that opioid peptides play a definite role in post-stress processes and that carboxypeptidase H may play a role in the formation of enkephalins and other peptides, including pituitary hormones. In this work, the authors studied the effect of various stress factors on carboxypeptidase H activity in different rat brain regions in order to determine if the level of regulator peptides could also depend on the enzyme's state. It was established that carboxypeptidase H activity increased as rat brain regions were subjected to various stress factors. The enzyme's activity increased in a continuous manner during emotional-pain stress. The authors concluded that carboxypeptidase H most likely participated in the restructuring of neuropeptide biosynthesis during adaptation to stress. References 10: 6 Russian, 4 Western.

Immunomodulating Effect of Ecdysterones

927C0489B Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian Vol 64 No 2, Mar-Apr 92 (manuscript received 18 Apr 91) pp 56-61

[Article by G. N. Fomovskaya, A. G. Berdyshev, and Yu. D. Kholodova; Institute of Biochemistry imeni A. V. Palladin, Ukrainian Academy of Sciences, Kiev; Institute of Molecular Biology and Genetics, Ukrainian Academy of Sciences, Kiev; UDC 577.27:577.117.2]

[Abstract] In this work, the effects of ecdysterone and its 20-deoxy derivative α -ecdysone, as well as 2-deoxyecdysterone and 2-deoxy- α -ecdysone, ecdysone 2, 3, 22-triacetate, and preparation BTI-4, on [3 H] thymidine incorporation into the lymphocytes of various populations of rats, mice, and humans were studied. It was shown that

at concentrations of 10^{-12} — 10^{-5} M, ecdysterone and its analogues had a significant stimulating effect on DNA biosynthesis in animal lymphocytes activated by polyclonal mitogenes. When ecdysterone concentrations were increased to 10^{-4} M, inhibition of concanavalin A's activating effect on DNA biosynthesis was observed in thymocytes. The effects of the studied ecdysterones did not depend significantly on their structure. Ecdysterone's stimulating effect on DNA synthesis was less pronounced for splenocytes than it was for activated thymocytes. It was established that ecdysterone is a significant inhibitor of DNA biosynthesis in cultures of activated concanavalin A from lymphocytes from the peripheral blood of healthy donors. Figures 4; references 17: 13 Russian, 4 Western.

Several Aspects of the Effect of Licorice Root Extract on Liver Parenchyma in Experimental Animals

937C0001A Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA BIOLOGICHESKIKH NAUK in Russian No 4, Jul-Aug 91 pp 51-54

[Article by Sh. M. Karimov and M. Yu. Lipchenko]

[Abstract] In this work, the authors utilized licorice root extract, a substance that exhibits reparative activity, as an agent for restoring liver structure and function in white mice that had been exposed to 317.4 mg/kg of magnesium chlorate (via a stomach probe) over a period of 10 days. On the basis of obtained morphological and morphometric data, it was determined that licorice root extract, upon intra-stomach injection into white mice after exposure to a pesticide (magnesium chlorate), stimulated reparative regeneration. Within a period of 15 days, normalization of liver structure and function occurred in the experimental mice, while hepatocytes still remained necrotically and dystrophically altered in the control group. The authors concluded that this fact justifies further study of licorice root extract activity with the goal of using it widely in hepatology for preventing chronic processes from occurring in the liver after exposure to pesticides. Figures 1; references: 9 Russian.

Effect of Met-Enkephalin and β -Endorphin on Conditioned Response in Hedgehogs

937C0065A St. Petersburg FIZIOLOGICHESKIY
ZHURNAL SSSR IMENI I.M. SECHENOVA
in Russian Vol 77 No 10, Oct 91 (manuscript
received 07 Feb 91) pp 10-19

[Article by T.N. Sollertinskaya and M. Obidova, Laboratory of Cerebral Evolution, Institute of Evolutionary Physiology and Biochemistry imeni I.M. Sechenov, USSR Academy of Sciences, Leningrad; UDC 612.821.+577.15/.17]

[Abstract] In order to further define the scope of action of endogenous opioids, Central Asian hedgehogs were employed in assessment of the effects of met-enkephalin (I), naloxone (II) and β -endorphin (III) (80-100 μ g/kg; s.c.) on conditioned food response. Administration of met-enkephalin resulted in complete inhibition of the conditioned response during the first four days. The effects were more profound in animals with induced inhibitory neurosis, whereas in animals with excitatory neurosis stereotypic motor behavior was enhanced. The latter was also accompanied by diminished food excitability and reduced chewing and swallowing rates. Naloxone injections counteracted the inhibitory sequelae of exogenous met-enkephalin. Studies with β -endorphin showed activation of the conditioned response and enhanced feeding patterns. In cases of excitable neurosis β -endorphin abbreviated the duration of the various latent parameters of the conditioned food response. In inhibitory neurosis β -endorphin prolonged the latent periods and reduced the rate of positive responses to 60-70 percent. These observations supplement the rather contradictory data on the involvement of the opioids in higher nervous function and demonstrate that their effects are more pronounced in neurotic states. Figures 5; references 23: 15 Russian, 8 Western.

Effects of Oxymethacil on Microcirculation and Discharge Rate of Cat Cortical Neurons in Acute Paraoxon Poisoning

937C0066A Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian Vol 112 No 8, Jun 91 (manuscript
received 18 Dec 90) pp 115-117

[Article by A.L. Kamenev, M.O. Samoylov, D.G. Semenov and G.A. Sofronov, Military Medical Academy of S.M. Kirov; Institute of Physiology imeni I.P. Pavlov, USSR Academy of Sciences, Leningrad; UDC 616.831-091.81-073.97+[616.16-031:611.81]-008.1099-02:615.917:547.241]-02:615.272.4.014.425]

[Abstract] Prophylactic trials were performed on 3-3.5 kg cats to assess the efficacy of oxymethacil (6-methy-5-oxyuracil) in mitigating paraoxon toxicity. Intravenous administration of paraoxon (0.8 mg/kg) resulted in complete cessation of cortical microcirculation and a sharp drop in BP within two minutes, followed in five minutes by complete cortical electrical silence. Treatment with benactyzine (0.5 mg/kg; i.v.) was ineffective. Pretreatment with oxymethacil (5.0 mg/kg; i.v.) 60 minutes before

paraoxon administration alleviated but did not prevent the course of clinical deterioration. Treatment of the latter animals with benactyzine 20 minutes after paraoxon induced a gradual recovery of cortical microcirculation and BP. Recovery of cortical electrical activity occurred 20 minutes after benactyzine and was followed by hyperactivity. These observations implicate direct action of the antioxidant oxymethacil on M-cholinergic receptors and demonstrate the efficacy of combined use of oxymethacil in the prophylactic mode and benactyzine in the therapeutic mode in organophosphorus toxicity. Figures 3; references 14: 7 Russian, 7 Western.

Central and Peripheral μ - and δ -Opiate Receptors in Antiarrhythmic Mechanism of Action of Enkephalins

937C0066B Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian, Vol 112 No 8, Jun 91 (manuscript
received 20 Jun 90) pp 124-126

[Article by L.N. Maslov and Yu.B. Lishmanov, Laboratory of Radionuclide Research Methods, Scientific Research Institute of Cardiology, Tatar Scientific Center, USSR Academy of Sciences, Tomsk; UDC 616-003.725+615.22]

[Abstract] Intravenous injections of dalargin, morphine, naloxone, and dalargin + naloxone combination were employed in 200-250 g male rats with induced ventricular fibrillations in order to assess the relative involvement of μ - and δ -opiate receptors in the antiarrhythmic action of enkephalins. The study was also complemented by dalargin infusion into the fourth lateral ventricle. In all cases occlusion of left anterior coronary arteries was employed to induce myocardial ischemia. On balance, the resultant observations were interpreted to indicate that the antiarrhythmic mechanisms of action of receptors and central μ receptors. Tables 1; references 15: 5 Russian, 10 Western.

Stress Adaptation Enhances Stability of Cardiocyte Nuclear DNA by Nuclear Accumulation of Heat Shock Proteins

937C0066C Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian, Vol 112 No 8, Jun 91 (manuscript
received 10 Nov 90) pp 126-128

[Article by I.Yu. Malyshev, A.V. Zamotrinskiy and F.Z. Meyerson, Scientific Research Institute of General Pathology and Occupational Pathology, USSR Academy of Medical Sciences, Moscow; UDC 613.863-092.19:[612.17.014.22.015:577.112]-092.9]

[Abstract] A study was conducted with 200-250 g male Wistar rats was designed to determine whether adaptation to stress promotes accumulation of heat shock proteins [hsp]—in particular hsp70—in heart cell nuclei. The results demonstrated that adaptation to immobilization was accompanied by a marked increase in the stability of heart nuclear DNA to in vitro degradation following addition of 50 μ g/ml of exogenous single-stranded DNA. In the unadapted rats DNA degradation was on the order

of 43 percent, while maximum degradation in the case of stress-adapted rats was 8 percent. Increased stability of the histone-DNA complex was shown to be accompanied by and attributed to accumulation of hsp70 in the nucleoplasm in the adapted animals. A single stressful event did not lead to hsp70 accumulation in the heart nuclei nor alter susceptibility of the nuclear DNA to degradation. Figures 3; references 15: 6 Russian, 9 Western.

Repeated Stress and Dalargin Effects on Proliferation of Gastric Mucosa

937C0066D Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian, Vol 112 No 8, Jun 91 (manuscript
received 05 Feb 91) pp 130-132

[Article by S.S. Timoshin, S.I. Shvets, M.I. Radivoz, A.G. Aleksandrovich and Ye.I. Melnik, Central Scientific Research Laboratory, Khabarovsk Medical Institute; UDC 612.841.0143:612.6.014.43]

[Abstract] An analysis was conducted on the effects of dalargin on the synthesis of DNA in pyloric mucosa of 160-180 g female albino rats subjected to various stress factors. The radiolabeling results demonstrated that five-fold stressing with hypoxia (9000 m equivalent in pressure chamber for one hour), sublethal hyperthermia (41.5°C for 1 h) and immobilization led to a 1.57- to 1.9-fold reduction in DNA synthesis within one hour of the last challenge. Pretreatment with dalargin (10 µg/kg; i.p., 45 min before stress) normalized DNA synthesis in hypoxic stress, increased synthesis above control levels in hyperthermia, and improved but did not correct DNA synthesis in animals that had been immobilized. In untreated hypoxic and immobilized rats a rebound phenomenon in DNA synthesis was observed after 24 hours, whereas in the hyperthermic group synthesis remained depressed. The effects of dalargin after 24 hours consisted of normal rates of DNA synthesis in the hyperthermic and immobilized groups and attenuated synthesis in the hypoxic group. Finally, none of the stress factors affected histamine concentrations; however, dalargin pretreatment significantly enhanced histamine levels in the immobilized group. Accordingly, these findings point to the multifaceted action mechanisms of dalargin in promoting proliferation of gastric mucosa under different forms of stress. Figures 1; tables 1; references 15: 13 Russian, 2 Western.

Modulation of Brain Catecholamine Levels by Anti-Dopamine β-Monooxygenase Antibodies

937C0066E Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian, Vol 112 No 8, Jun 91 (manuscript
received 16 Nov 90) pp 133-134

[Article by A.S. Pogosyan, A.S. Boyadzhyan, K.G. Karagezyan, V.A. Ayvazyan and A.V. Movsesyan, Laboratory of Lipid Biochemistry, Institute of Experimental Biology, Armenian SSR Academy of Sciences, Yerevan; UDC 616.895.8-092.9-07:616.831-008.94:577.175.523]-02:[616.831-008.931:577.152.143]

[Abstract] Suboccipital injection of rabbit anti-dopamine β-monooxygenase IgG (2.6 µg/g) into 150-200 g male albino rats resulted in virtual disappearance of norepinephrine and an approximately three-fold increase in brain levels of dopamine within one hour. These findings demonstrated that inhibition of dopamine β-monooxygenase—which is responsible for dopamine to norepinephrine conversion—by specific antibody may be used to model schizophrenia in animals since this type of catecholamine imbalance has been observed in schizophrenic patients.

Repair of Hepatic Mitochondrial Membranes by Phosphatidylcholine Liposomes

937C0066F Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian Vol 112 No 8, Jun 91 (manuscript
received 11 Nov 90) pp 135-136

[Article by O.V. Dobrynin, V.L. Migushina, S.Z. Shatinina and A.B. Kapitanov, Chair of Biochemistry, Medical Biological Faculty, 2d Moscow Medical Institute imeni N.I. Pirogov; Scientific Research Institute of Physicochemical Medicine, RSFSR Ministry of Health, Moscow; UDC 616.36-002-099-092.9-07616.36-003.93-02:615.31:547.953]

[Abstract] Egg yolk phosphatidylcholine (PC) was tested for its efficacy in alleviating carbon tetrachloride (CT)-induced membrane damage of hepatic mitochondria. Within 48 h of intraperitoneal injection of 0.2 ml/kg of CT to 90-180 g outbred male rats mitochondrial H⁺-ATPase activity increased fourfold, the acceptor-control ratio fell 3.5-fold, membrane phospholipids decreased to 67 percent of control level, rotational correlation times of fluorescent probes decreased from 12.2 to 9.3 nsec, and membrane microviscosity was reduced from 700 to 530 mPa x sec. Treatment of the animals with PC multilayer liposomes (10 mg/100 g; i.p.) 24 h after CT administration alleviated or reversed the changes seen in untreated animals, indicating a substantial degree of mitochondrial membrane repair and functional recovery. Partial repair was also evident in the chemical composition of the membranes, although the composition remained altered and an unidentified fraction appeared in the membranes of untreated and treated rats. These findings demonstrate the therapeutic potential of exogenous phosphatidylcholine in alleviating chemical hepatotoxicity. Tables 3; references 16: 12 Russian, 4 Western.

Pharmacologic Modulation of Opioid Analgesia

937C0066G Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian, Vol 112 No 8, Jun 91 (manuscript
received 13 Feb 91) pp 151-155

[Article by V.N. Zhukov and Yu.Yu. Troyan, Laboratory of Analgesic Pharmacology, Institute of Pharmacology, USSR Academy of Medical Sciences, Moscow; UDC 615.212.7.015.21:615.214.31].076.9]

[Abstract] Various neurotropic agents have been shown to potentiate the analgesic effects of opioids, although they

may lack intrinsic analgesic potential and do not interact with opioid receptors. Accordingly, 21 such agents—representing various classes of neurotropics—were analyzed in an attempt at a better understanding of their mechanism(s) of action. The studies on outbred 18-20 g male mice involved tail flick, hot plate, and tail squeeze tests. A given agent was administered 45 min before the test, followed by morphine (3 mg/kg; s.c.; 25 min before the test) and then by naloxone (1 mg/kg; i.p.; 15 min before the test). In selected experiments morphine was administered intracisternally (0.5 µg/kg) 30 min before pain testing. Morphine analgesia was potentiated to various degrees, although some drugs were efficacious in only some of the tests and some in all methods of assessment. The results were difficult to interpret and the mechanisms underlying potentiation remain enigmatic. Nevertheless, putative mechanisms may involve stimulation of endogenous opioids and enhancement of receptor affinity for morphine, although enhancement of morphine permeation of the blood-brain barrier appears unlikely. Finally, some agents exhibited an additional benefit by stimulating morphine-depressed respiratory drive. Figures 3; references 9: 5 Russian, 4 Western.

Taurine Modulation of Neuronal Potassium Ion Currents

937C0067D Leningrad VESTNIK
LENINGRADSKOGO UNIVERSITETA: BIOLOGIYA
in Russian Vol 24 No 4, Nov 91 (manuscript received
07 Feb 91) pp 46-50

[Article by A.I. Vislobokov, A.G. Kopylov, V.V. Mantsev,
V.S. Gurevich; UDC 577.352.56:612.813:612.822.3]

[Abstract] Unidentified neurons of the visceral and parietal ganglia of the pond snail *Lymnaea stagnalis* were employed in electrophysiological studies intended to define the action of taurine on potassium channels. The voltage-clamp studies demonstrated that at a fixed membrane potential of -80 mV and a +30 mV testing potential 10^{-8} M taurine was without effect on slow K currents. In 10^{-7} M taurine the slow current decreased by 15.2 percent and in 10^{-2} M taurine by 65.2 percent. Over the same concentration range taurine did not affect rapid K currents at a fixed membrane potential of -110 mV and a testing

potential of +40 mV. Further, the volt-ampere characteristics of the membranes were not shifted and the effects were entirely reversible, indicating relatively weak binding of taurine to potassium channels. Figures 4; tables 2; references 19: 11 Russian, 8 Western.

Regional Activities of Enkephalin and Angiotensin-II Forming Peptidases in Rat Brain and Peripheral Tissues in Relation to Ethanol Preference

937C0067E Moscow VOPROSY MEDITSINSKOY
KHIMII in Russian Vol 37 No 4, Jul-Aug 91
(manuscript received 01 Feb 90) pp 33-37

[Article by O.A. Gomazkov, A.D. Panfilov, A.P. Rostovtsev, N.V. Komissarova, V.V. Fomin and O.O. Grigoryants, Institute of Biological and Medical Chemistry, USSR Academy of Medical Sciences, Moscow; UDC 616.89-008.441.13-092.9-07:[616.831-008.931:577.152.34]

[Abstract] An analysis was conducted on activities of carboxypeptidase H (CPH) and angiotensin-converting enzyme (ACE) in brain and peripheral tissues of male Wistar rats differing in preference for water or 20 percent ethanol. The animals received only 20 percent ethanol for 40 days, followed by a two week period of free choice to determine preference. At the conclusion the biochemical studies demonstrated that CPH—responsible for enkephalin production—was significantly ($p < 0.05$) elevated in the midbrain, striatum, and adrenal glands of water-preferring (WP) rats, and in the pituitary and striatum of the ethanol-preferring (EP) animals. Statistically significant elevations of ACE were observed in the pituitary, striatum, and lungs of the WP rats, while renal ACE showed significant depression. In the EP rats ACE was significantly elevated in the pituitary gland, striatum, and lungs in comparison with control rats, whereas thalamus + hypothalamus levels were depressed in comparison with control, and WP rats, and renal ACE activity was significantly elevated in comparison with the WP animals. The changes in both experimental groups were regarded as reflecting the pathogenetic sequelae of initial ethanol overload and establishment of altered homeostatic mechanisms. Figures 2; tables 3; references 28: 8 Russian, 20 Western.

Mental Health Statistics in USSR

937C0060A Moscow *ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S.S. KORSAKOVA* in Russian
Vol 91 No 11, Nov 91 pp 19-23

[Article by N.A. Tvorogova, Department of Scientific Administration of Psychiatric Services, All-Union Union Scientific Research Institute of General and Forensic Psychiatry imeni V.P. Serbskiy, USSR Ministry of Health, Moscow; UDC 616.89-036.2-07:313.13(47+57)]

[Abstract] Extensive reorganization of health services and privatization of medical care in the USSR have led to a reassessment of current psychiatric hospitalization practices with emphasis on greater reliance on outpatient care of mental patients. A three year statistical analysis (1988-1989) has shown that by 1989 the percentage of psychiatric cases treated in the hospital setting had fallen from 87.7 percent in 1987 to 82.2 percent in 1989. Concomitantly, outpatient registry of such patients rose from 12.3 percent in 1987 to 17.8 percent in 1989. Overall, during the last two years the total number of psychiatric patients registered in hospitals and outpatient facilities decreased some 6.7 percent (440,100 cases) due to changes in diagnostic criteria and reorganization of the health services. In order to have more accurate and comprehensive data on mental health statistics in the future, it will be necessary to monitor and elicit patient data from private health facilities as well. Tables 1.

Perception of Radiation Health Risk and Health Self-Assessment in Areas With Strict Radiation Monitoring

937C0060B Moscow *ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S.S. KORSAKOVA* in Russian
Vol 91 No 11, Nov 91 (manuscript received 20 Apr 91)
pp 49-53

[Article by V.P. Ferents, V.A. Prilipko and I.D. Bliznyuk, All-Union Scientific Center for Radiation Medicine, USSR Academy of Medical Sciences, Kiev; UDC 616.89-02:614.876-07]

[Abstract] Questionnaire-based studies were conducted in an area affected by the Chernobyl fallout (1200 subjects) and a pristine region (400 subjects) to assess the impact of strict radiation monitoring on health and other attitudes. The results revealed that 71.6 percent of the respondent lacked objective knowledge regarding radiation-related health problem and that 71.1 percent had obtained their information from mass communication media. Special lectures served as an information source for 15.9 percent of the people, while 21.9 percent had also obtained some information from health care workers. However, 74.5 percent of the respondents were dissatisfied with the quality of the information, 68.1 percent of those in the radiation-polluted area felt that their health was in danger, while 89.6 percent reported radiation-related anxiety and fear. Finally, 13.4 percent perceived themselves as healthy, 63.8 percent felt their health to be suboptimal, 21.7 percent felt ill and 1.1 percent considered themselves to be seriously ill. In the area with strict radiation monitoring 81.8 percent of the respondents were opposed to nuclear energy versus 74.1 percent in the control area. These findings indicate that health education vis-a-vis radiation needs to be improved, as well as the fact that in some cases resettlement is indicated to alleviate the mental stress of living in areas at risk. References 7: 4 Russian, 3 Western.

Clinical Course of Digestive Organs Diseases in Chernobyl Victims

937C0061A Kiev VRACHEBNOYE DELO in Russian No 10, Oct 91 (manuscript received 20 Jun 91) pp 65-68

[Article by V.G. Perederiy, N.G. Bychkova, A.A. Fomina, A.S. Loginov and Ye.N. Trach, 1st Chair of Therapeutics Faculty, Kiev Medical Institute; UDC 616.3:614.876]

[Abstract] Examination of 1905 registrants at a gastroenterological clinic in Kiev and healthy controls revealed that digestive organ disease was present in 1775. That cohort included 275 workers from the Chernobyl nuclear power plant, 45.5 percent of whom were afflicted with gastritis and gastroduodenitis, 27.7 percent with gastric ulcers and 9.45 percent with esophagitis (usually reflux). Onset of disease and/or its exacerbation was directly related to the length of stay in Chernobyl and attributed to internalization radionuclides. In addition, the more severe cases were accompanied by marked suppression of cellular immunity indicating the need for immunocorrective therapy. References 4: Russian.

Lymphocyte Counts, Function and Cytogenetics in Relation to Immunity in Chernobyl Cleanup Personnel

937C0061C Moscow GEMATOLOGIYA I TRANSFUZIOLOGIYA in Russian Vol 36 No 8, Aug 91 (manuscript received 06 Feb 91) pp 24-26

[Article by A.V. Akleyev and M.M. Kosenko, Institute of Biophysics, USSR Ministry of Health, Moscow; UDC 616.155.32-097-02:614.876]-076.5]

[Abstract] Lymphocyte counts, function, and cytogenetics were monitored in 90 male Chernobyl cleanup workers over a three year period. Exposure for this cohort did not exceed 25 rem. The resultant data did not reveal any significant deviations, although one month after exposure large granulocytic lymphocyte counts showed modest depression (2.79 percent), with full recovery to baseline counts in three years. Serum IgM concentrations (0.68 g/L) were depressed 1-2 months after exposure, followed by a rebound phenomenon for two years and reduction to baseline values by the 3d year. These findings cannot be related directly to ionizing radiation alone, but have to be viewed in light of mental stress, lifestyle changes, isolation, chemical exposure, and so forth. Figures 2; tables 2; references 9: Russian.

Rehabilitation of Myocardial Infarction Patients in Vicinity of Chernobyl Nuclear Power Plant

937C0075A Kiev VRACHEBNOYE DELO in Russian No 7, Jul 92 (manuscript received 24 Jun 91) pp 9-11

[Article by I.K. Sledzevskaya, M.G. Ilyash, prof., and Ye.V. Vyatchenko, dr. med. sci., Kiev Scientific Research Institute of Cardiology imeni N.D. Strazhesko; UDC 616.127-005.8-036.82/86]

[Abstract] Clinical assessment was conducted on three groups of patients with myocardial infarction ranging in age from early- to mid-forties with approximately similar clinical features. Group I (26) consisted of subjects that

had participated in Chernobyl cleanup efforts, Group II (29) of residents of an area under strict radiation monitoring, and Group III (25) of residents of Kiev. During the first year of follow-up, recurrent infarction was diagnosed in nine patients in Group I, in two patients in Group II ($p < 0.05$), and in five in Group III ($p < 0.05$). Group II patients were less tolerant of physical exertion (54.8 W) than Groups I (78.6 W; $p < 0.05$) and III (81.6 W; $p < 0.05$). These findings point to the possible involvement of radiation-related stress in Group I as a predisposing factor to recurrent infarctions, and for the need for closer monitoring of myocardial contractility in Group II-type cases. References 5: Russian.

Acute Pneumonia and Prolonged Exposure to Chernobyl-Related Low-Dose Ionizing Radiation

937C0075B Kiev VRACHEBNOYE DELO in Russian No 7, Jul 92 (manuscript received 28 Jun 91) pp 11-15

[Article by M.Yu. Kolpakov, V.I. Maltsev, V.A. Yakobchuk, V.I. Shatilo and N.N. Kolpakova, Department of Health, Zhitomir Oblast Executive Committee; Ovruch Central Rayon Hospital; UDC 616.24-002+612.014.481+614.876]

[Abstract] An area in the Zhitomir Oblast—subject to radiation monitoring as a result of the Chernobyl accident (mean Cs contamination of 5.5 Cu/km²; background gamma activity of 40-60 μ Ci/h)—with a population of 7100 adults was analyzed for acute pneumonia statistics from 1 May 1986 to 1 May 1990. Health statistics covering the period 1 May 1984 to 1 May 1985 were used for retrospective control data. The fundamental results demonstrated that the incidence of acute pneumonia fell from 1.3/100 in the control period to 1.0/100 following the Chernobyl accident. However, the incidence of severe, protracted forms increased by 14.6 percent in the post-Chernobyl phase. In conjunction with the results of laboratory studies, the data were interpreted to reflect a complex interplay between immunity and the effects of low-dose ionizing radiation. On the one hand, enhancement of certain immune parameters could be used to explain overall reduction in morbidity due to acute pneumonia and on the other adverse effects could contribute to the gravity of the protracted cases. References 10: Russian.

Analysis of the Results of Revealing Thyroid Diseases in Mass Preventive Examinations of the Population of Bryansk Oblast

937C0087A Moscow MEDITSINSKAYA RADIOLOGIYA in Russian Vol 37 No 3-4, Mar-Apr 92 p 35

[Article by I. B. Voronetskiy, G. A. Zubovskiy and N. I. Terekhin]

[Text] Incorporation of radioactive iodine as a result of the accident at the Chernobyl Nuclear Power Plant necessitated preventive examinations to reveal changes in the thyroid of inhabitants of regions exposed to radionuclide contamination. Complaints and medical histories were gathered together and the thyroid was examined and palpated as part of the examinations in the first few years

after the accident. After apparatus was made available to the regions in question in 1989, mass ultrasonic examinations of the thyroid were initiated.

The results of a clinical survey of 12,053 inhabitants in monitored regions, conducted in 1986-1987, and the results of ultrasonic examination of 11,614 inhabitants of Krasnogorskiy Rayon, Bryansk Oblast (1989-1990) were analyzed in order to evaluate the effectiveness of these examinations. The comparison showed that in comparison with clinical examination and treatment in the first years of work, which made it possible to detect organic damage to the thyroid in 11.6 percent of the subjects, use of ultrasonic apparatus tripled the frequency of detection of disease and hyperplasia of the thyroid (33.8 percent). Nodes were diagnosed seven times more frequently (in 10 percent of the population as opposed to 1.4 percent), and in 44.5 percent of the patients the diameter was less than 10 mm, at which they are impossible to palpate.

The effectiveness of ultrasonic examination is explained in particular by the fact that it permits detection of three-dimensional formations up to 1 cm in diameter and impalpable nodes of the thyroid of larger volume.

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New Domestically Manufactured Digital Angiography Unit

937C0087B Moscow MEDITSINSKAYA RADIOLOGIYA in Russian Vol 37 No 3-4, Mar-Apr 92 p 42

[Article by G. A. Onopriyenko, A. I. Morozov, I. N. Demidov and S. V. Korolev]

[Text] Angiography has firmly established itself in practical medicine as one of its clinical diagnostic subdivisions. Development of digital image processing in recent years has dramatically expanded the possibilities of angiography. However, digital angiography involves the use of complex apparatus which is being produced by only a few Western firms; moreover it is very expensive. This limits wide introduction of digital angiography into practical public health.

Together with the State Scientific Research Institute of AS [not further identified] the X-ray department of MONIKI [Moscow Oblast Clinical Scientific Research Institute imeni M. F. Vladimirovskiy] developed an experimental model of a domestically manufactured digital angiography unit built practically entirely out of Russian components. This device is being tested out and the applications software is being debugged in the angiographic office of MONIKI. In terms of its functional possibilities the unit satisfies modern requirements, and it is oriented on existing world standards. It can process an image in the subtraction, "window," road-mapping, and time interval difference modes. Digital processing is opening up new possibilities for solving the problems of permanent data storage. All processed images can be stored on floppy disks and with any video recorder having a standard video signal input. The possibility of obtaining imagery with a laser printer with practically no deterioration of image quality deserves special attention. Images can be reproduced on

paper in a few minutes, bypassing the traditional photochemical process. A copy can be obtained just as quickly from an image in permanent storage.

A minimum quantity of contrast medium—one-fifth of that used in standard angiography—was injected in initial tests using image digitization. Intravenous contrasting was carried out as well. High quality visualization of large and mid-sized arteries was achieved.

The domestically produced digital angiography unit opens up a possibility for wide practical introduction of a more effective and safer method of examining patients with vascular pathology.

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Use of Low-Intensity Electromagnetic Waves in the Millimeter Band in Medicine

937C0087C Moscow MEDITSINSKAYA RADIOLOGIYA in Russian Vol 37 No 3-4, Mar-Apr 92 pp 53-54

[Article by O. V. Betskiy; UDC 616-002.582-073.916]

[Text] Practical uses were found for electromagnetic waves immediately after their discovery and after their first sources were developed. One hundred years have passed since that time. About 50 years ago, electromagnetic waves came into intensive use in radio communications, radar, navigation and television. Nontraditional areas of their use came into being simultaneously—in medicine, biology, bioengineering, etc.

The specific areas of practical use of electromagnetic radiation are determined primarily by oscillation frequency (or wavelength), as well as by energy quanta. In terms of this characteristic, electromagnetic radiation is subdivided into ionizing and nonionizing.

Much attention has been devoted in recent years, both on a scientific plane and in the applied aspect, to electromagnetic waves in the millimeter band (in frequency terms, this band is called extremely high-frequency, or EHF). Millimeter waves ($\lambda = 1-10$ mm in free space) are categorized as nonionizing radiation; in this case the quantum of energy in this band is less than the energy of thermal motion of a kT of atoms or molecules, and it can affect only their rotational degrees of freedom. We believe that millimeter waves are able to convey information to biological objects when the intensity of radiation corresponds to so-called nonthermal levels (from tens of microwatts to units of milliwatts of power over a 1 cm² irradiated surface).

The honor of developing the world's first sources of determined oscillations in the millimeter band and the scientific ideology of their practical use in medicine to treat various diseases belongs to Russian scientists N. D. Devyatkov, M. B. Golant and others (this was approximately in the mid-1960's). The very first experimental studies conducted in our country made it possible to formulate the key features of the biological effects of millimeter radiation: The effect of their action is often frequency-dependent; when we look at the relationship of the biological effect to radiation power, we find a clearly pronounced plateau, over the limits of which power varies by an order of magnitude or more.

However, the most remarkable property of EHF radiation is that the biological (therapeutic) effect is indirect (a positive effect is noted in organs that are unattainable by electromagnetic waves).

Intensive absorption by water or aqueous solutions is an important property of millimeter waves. Thus, at a wavelength of $\lambda \approx 8$ mm (which corresponds to one of the wavelengths of a series-produced EHF therapy unit), a layer of water only 1 mm thick attenuates radiation by approximately 100 times. It follows from this example in particular that when we irradiate human skin, which is over 60 percent water, the radiation is practically completely absorbed in the epidermal and dermal layers.

Nonetheless, skin receptors, including free nerve endings, T-lymphocytes and vascular microcapillaries, which take part in primary reception of millimeter waves, are found to be within the field of "action" of millimeter waves.

Theoretical and experimental research conducted in this country prepared the soil for clinical testing of the EHF therapy method (mention should be made here primarily of the pioneering works of L. A. Sevastyanova, A. Z. Smolyanskaya, N. P. Zalyubovskaya, S. Ye. Manoylov, R. I. Kiselev, S. D. Pletnev, M. B. Golant, V. F. Kondratyeva, E. S. Zubenkova, T. B. Rebrova, E. A. Gelvich, M. V. Poslavskiy and others). The origin of EHF therapy falls in 1977 (treatment of gastric and duodenal ulcers—V. A. Nedzvetskiy, N. A. Cherkasov). EHF radiation is now being used successfully in dozens of the country's therapeutic institutions to treat diseases such as cardiac ischemia, hypertension, some forms of diseases and afflictions of vessels of the brain and lower limbs, cancer, for pain relief, traumatology and orthopedics, and so on. Typical features of EHF therapy include noninvasiveness, the possibility of monotherapy (without drugs), polytherapeutic action, and absence of side effects and remote consequences (over a period of more than 10 years).

As often happens in medicine, the successes in applying millimeter waves are ahead of our understanding of the physical mechanisms of their action upon different biological objects. A general hypothesis covering different effects has now been formulated—from initial reception of radiation by molecules of free and bound water and the work of protein receptors on biological membranes and their influence on cell metabolism, to biochemical, humoral and nervous information transmission channels providing for the integral reaction of the organism. Also original is the idea of intrinsic EHF radiation in living organisms, which is used within them for the purposes of controlling and distinguishing between amplitude-frequency characteristics of the radiation of healthy and sick organisms; also original is the idea of the role of external radiation from EHF therapy units, which performs the function of a synchronizing signal, like that used in radio engineering.

Seven all-union seminars on applications of low-intensity millimeter waves in medicine and biology have been conducted in the last 15 years. Seven collections on specific subjects have been published. The incomplete bibliography on the problem contains over 1,000 titles.

Organization of a temporary "EHF" collective on the basis of a decision of the USSR State Committee for Science and Technology and the USSR Academy of Sciences was a logical conclusion to the almost 25 years of work carried out by scientists and engineers in our country under the guidance of Academician N. D. Devyatkov. The collective was given the tasks of widely testing the EHF therapy method in the treatment of various diseases, developing the scientific conceptions for the mechanisms of action of low-intensity radiation upon biological objects, and preparing therapeutic apparatus for production.

Such apparatus is already in series production (Yav-1 and Elektronika KVCh), and several thousand patients have been cured with its help. Apparatus of a new generation is in the development stage—dynamic EHF therapy, including with biological feedback, various forms of the radiated signal, etc.

This issue of the journal offers four articles selected from the more than 100 works submitted at the last All-Union Seminar on Applications of Low-Intensity Millimeter Waves in Medicine and Biology. We can be assured that they will create an impression in the reader's mind of a new scientific and practical direction in modern medicine—EHF therapy.

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Analysis of Medical Statistics for the Purpose of Assessing Genetic and Teratogenic Effects of the Accident at the Chernobyl Nuclear Power Plant
937C0087D Moscow MEDITSINSKAYA RADIOLOGIYA
in Russian Vol 37 No 3-4, Mar-Apr 92 pp 59-63

[Article by N. P. Bochkov, A. Ye. Romanenko, G. I. Razumeyeva and V. V. Yakovlev, Moscow Medical Academy imeni I. M. Sechenov, Ukrainian Scientific Center of Radiation Medicine, and the Center for Medical Genetics, Russian Academy of Medical Sciences; UDC 616-005.5/.7-02:614.876]-07:313.13]

[Text] Introduction

Change in the radio-ecological situation over large areas as a result of the accident at the Chernobyl Nuclear Power Plant doubtlessly requires that we assess the genetic and teratogenic consequences of the elevated radiation level. Analysis of chromosomes in lymphocytes in the peripheral blood of people residing in zones of radioactive fallout revealed a higher level of radiation-induced mutations^{1,4,7}. As we know from the experience of studying the consequences of atomic bombing of Hiroshima and Nagasaki, it is significantly more difficult to reveal genetic effects in embryonic cells than in somatic cells^{11,16}. The frequency of congenital developmental defects and hereditary diseases was studied in some regions following the Chernobyl accident. The results of this research are contradictory.

Thus, no increase in the frequency of congenital and hereditary pathology was revealed in Hungary in 1978-1989¹⁴.

In Belarus, good records have been maintained since 1984 on congenital developmental defects over the entire territory, which can serve as a control. Research was continued in 1986 with the territory divided into radioactively contaminated and control regions⁵. The authors note some increase in the frequency of congenital developmental defects following the accident in contaminated regions, though they do not associate this increase directly with irradiation as yet; they recommend continuing the research.

No significant increase in the frequency of congenital developmental defects and spontaneous abortions was noted in Kiev².

The goal of this paper is to analyze statistical data from records of congenital developmental defects and spontaneous abortions as a means of monitoring genetic and teratogenic effects associated with the accident at the Chernobyl Nuclear Power Plant and with other ecological changes.

Materials and Methods

Official medical demographic statistics of the Ukrainian SSR pertaining to individual oblasts and to the republic as a whole (population, birth rate, number of births, number of spontaneous abortions and abortions due to medical indications, and number of children with congenital defects) were used in the study. These data were used as the basis for calculating the frequencies of spontaneous abortions and births of children with congenital defects. Inasmuch as radiation-induced genetic effects could not have appeared in children before 1987 (irradiation began on 26 April 1986), and teratogenic effects could have appeared only at the very end of 1986, we can consider 1985 and 1986 to be the control years, and 1987-1989 to be the years of radiation exposure. As far as spontaneous abortions of genetic etiology are concerned, we can expect them as early as 2-3 months after the beginning of induced effects, and in the time thereafter.

Another approach to establishing irradiated and control samples is to compare oblasts receiving radioactive fallout (Zhitomir and Kiev oblasts) and without fallout (all others). Fallout did occur in other oblasts (Chernigov, Rovno), but the doses and the area of irradiation were insignificant in them. Thus we can consider three groups of variations in the frequencies of congenital developmental defects and spontaneous abortions: 1—all oblasts in 1985 and 1986, 2—

oblasts with no radioactive fallout in 1987-1989, and 3—oblasts with radioactive fallout in 1987-1989.

The calculated doses of external and internal irradiation (the effective equivalent dose) as a result of the Chernobyl accident received by the population, on the average per person in Kiev and Zhitomir oblasts, are presented in Table 1. Standard statistical methods were used to reveal the significance of the differences: Uniformity with respect to oblasts was checked, and the direction of changes in the temporal dynamics of indicators for each oblast was determined⁶.

Table 1. Average Individual Doses of Internal (From Radioactive Cesium) and External Irradiation of Inhabitants of Kiev and Zhitomir Oblasts in the Period Following the Accident (in cZw)

| Year | Kiev Oblast | | Zhitomir Oblast | |
|-----------------------|----------------------|----------------------|----------------------|----------------------|
| | External Irradiation | Internal Irradiation | External Irradiation | Internal Irradiation |
| 1986 | 0.46 | 0.13 | 0.38 | 0.11 |
| 1987 | 0.07 | 0.08 | 0.06 | 0.08 |
| 1988 | 0.06 | 0.09 | 0.05 | 0.09 |
| 1989 | 0.06 | 0.07 | 0.05 | 0.07 |
| 1986-1989 | 0.65 | 0.37 | 0.54 | 0.35 |
| Total dose, 1986-1989 | 1.02 | | 0.89 | |

Results and Discussion

Variations in medical demographic indicators in different Ukrainian oblasts in different years were insignificant, the differences being 5-15 percent. In connection with this we can achieve an impression of the factual material (the sizes of the samples) by averaging the data over five years (Table 2).

As we can see from Table 2, the sizes of the population samples are from 1,000,000 to 2,000,000 in most oblasts. The smallest sample was in Sevastopol (388,000), while the largest was in Donetsk Oblast (5,356,000). In five years the Ukrainian population increased insignificantly: From 50,771,600 in 1985 to 51,770,200 in 1989. The birth rate began to decline after 1986: 1985—15.0; 1986—15.5; 1987—14.8; 1988—14.5; 1989—13.3. The birth rate indicators of different oblasts (see Table 2) differ within the following limits: The minimum birth rate was noted over the five year period in Chernigov Oblast (12.7), and the maximum rate was noted in Transcarpathian Oblast (18.3).

Table 2. Medical Demographic Indicators for Ukraine in 1985-1989, Normalized for 1 Year

| Oblast, Region | Population, x1,000 | Birth Rate | Number of Births in 1 Year | Number of Spontaneous Abortions in 1 Year | Number of Children With Congenital Developmental Defects in 1 Year |
|----------------|--------------------|------------|----------------------------|---|--|
| Vinnitsa | 1,940 | 13.7 | 26,555 | 1,075 | 583 |
| Volyn | 1,040 | 17.4 | 18,202 | 581 | 398 |
| Lugansk | 2,853 | 14.1 | 40,062 | 2,190 | 604 |
| Dnepropetrovsk | 3,865 | 14.6 | 52,893 | 2,180 | 1,051 |
| Donetsk | 5,356 | 13.4 | 69,858 | 3,297 | 1,311 |
| Zhitomir | 1,538 | 14.7 | 22,976 | 625 | 437 |

Table 2. Medical Demographic Indicators for Ukraine in 1985-1989, Normalized for 1 Year (Continued)

| Oblast, Region | Population, x1,000 | Birth Rate | Number of Births in 1 Year | Number of Spontaneous Abortions in 1 Year | Number of Children With Congenital Developmental Defects in 1 Year |
|--------------------|--------------------|------------|----------------------------|---|--|
| Transcarpathian | 1,217 | 18.3 | 22,503 | 1,048 | 331 |
| Zaporozhye | 2,069 | 14.5 | 29,651 | 1,372 | 374 |
| Ivano-Frankovsk | 1,389 | 16.8 | 23,690 | 547 | 508 |
| Kiev | 1,914 | 14.6 | 26,816 | 1,174 | 564 |
| Kirovograd | 1,227 | 14.2 | 17,721 | 813 | 275 |
| Crimean | 2,003 | 15.1 | 30,986 | 1,688 | 382 |
| Lvov | 2,693 | 15.8 | 42,400 | 1,179 | 518 |
| Nikolayev | 1,313 | 16.0 | 20,382 | 832 | 246 |
| Odessa | 2,620 | 14.6 | 38,837 | 1,847 | 489 |
| Poltava | 1,724 | 13.5 | 23,276 | 945 | 357 |
| Rovno | 1,170 | 17.8 | 20,245 | 547 | 331 |
| Sumy | 1,427 | 13.4 | 18,539 | 785 | 542 |
| Ternopol | 1,155 | 15.3 | 18,154 | 503 | 327 |
| Kharkov | 3,160 | 13.6 | 42,309 | 1,566 | 604 |
| Kherson | 1,235 | 15.9 | 20,020 | 813 | 349 |
| Khmelnitskiy | 1,524 | 14.2 | 21,657 | 733 | 304 |
| Cherkassy | 1,528 | 13.6 | 21,018 | 872 | 406 |
| Chernovtsy | 925 | 16.2 | 15,110 | 496 | 341 |
| Chernigov | 1,418 | 12.7 | 18,242 | 643 | 423 |
| Kiev | 2,555 | 14.1 | 34,826 | 923 | 1,006 |
| Sevastopol | 388 | - | 5,227 | 309 | 120 |
| Ukraine as a whole | 51,252 | 14.6 | 742,638 | 29,533 | 13,766 |

Table 3. Frequency of Births of Children With Congenital Developmental Defects (per 1,000 Newborn)

| Oblast, Region | Year | | | | | |
|-----------------|------|------|------|------|------|------------|
| | 1985 | 1986 | 1987 | 1988 | 1989 | In 5 Years |
| Vinnitsa | 19.5 | 21.7 | 23.5 | 22.9 | 22.1 | 21.9 |
| Volyn | 15.7 | 18.1 | 20.8 | 27.1 | 28.1 | 21.8 |
| Lugansk | 12.9 | 14.6 | 15.3 | 16.9 | 16.1 | 15.1 |
| Dnepropetrovsk | 23.7 | 19.8 | 19.6 | 16.7 | 19.5 | 19.9 |
| Donetsk | 23.0 | 21.1 | 20.8 | 21.5 | 21.9 | 21.6 |
| Zhitomir | 13.9 | 18.4 | 17.8 | 19.9 | 26.1 | 19.0 |
| Transcarpathian | 8.7 | 16.3 | 14.0 | 16.2 | 18.5 | 14.7 |
| Zaporozhye | 9.5 | 11.4 | 14.7 | 14.7 | 13.0 | 12.6 |
| Ivano-Frankovsk | 17.0 | 16.6 | 23.8 | 23.8 | 26.6 | 21.5 |
| Kiev | 21.1 | 18.9 | 19.2 | 21.2 | 25.1 | 21.0 |
| Kirovograd | 9.7 | 13.5 | 17.5 | 17.3 | 20.1 | 15.5 |
| Crimean | 9.8 | 11.2 | 11.7 | 13.9 | 15.2 | 12.3 |
| Lvov | 8.8 | 10.3 | 12.7 | 13.5 | 16.1 | 12.2 |
| Nikolayev | 5.9 | 9.9 | 14.7 | 14.5 | 16.1 | 12.1 |
| Odessa | 7.8 | 10.7 | 14.1 | 14.9 | 15.6 | 12.5 |
| Poltava | 13.7 | 16.0 | 16.5 | 14.4 | 16.0 | 15.3 |
| Rovno | 10.9 | 15.6 | 17.4 | 19.6 | 18.6 | 16.4 |

Table 3. Frequency of Births of Children With Congenital Developmental Defects (per 1,000 Newborn) (Continued)

| Oblast, Region | Year | | | | | |
|--------------------|------|------|------|------|------|------------|
| | 1985 | 1986 | 1987 | 1988 | 1989 | In 5 Years |
| Sumy | 17.4 | 23.2 | 36.3 | 35.4 | 35.6 | 29.2 |
| Ternopol | 8.7 | 17.3 | 19.1 | 20.1 | 25.7 | 18.0 |
| Kharkov | 11.7 | 11.9 | 14.5 | 16.1 | 17.8 | 14.3 |
| Kherson | 13.5 | 17.7 | 16.2 | 20.2 | 19.9 | 17.4 |
| Khmelnitskiy | 12.1 | 10.0 | 14.9 | 13.3 | 20.7 | 14.0 |
| Cherkassy | 18.0 | 15.2 | 19.0 | 25.0 | 19.8 | 19.3 |
| Chernovtsy | 23.1 | 21.1 | 24.1 | 22.4 | 22.2 | 22.6 |
| Chernigov | 20.0 | 19.6 | 29.5 | 22.8 | 24.5 | 23.2 |
| Kiev | 24.2 | 31.9 | 40.6 | 23.4 | 26.4 | 28.9 |
| Sevastopol | 14.4 | 16.5 | 19.9 | 23.6 | 29.2 | 20.5 |
| Ukraine as a whole | 15.3 | 16.6 | 19.1 | 19.0 | 20.5 | 18.0 |

Data on population and birth rate dynamics are presented only for information purposes. We will not discuss the causes of differences in them over the five year period or in different oblasts, inasmuch as they are based not so much on biological as on social causes.

The genetic and teratogenic effects of irradiation can be assessed from the frequency of births of children with congenital developmental defects¹⁸. Analysis of data obtained from official statistics from the standpoint of revealing the effects of the Chernobyl accident revealed the following (Table 3).

In control group 1 (1985-1986), the span of frequencies of children with congenital developmental defects in all of the oblasts was from 5.9 to 31.9. The average for two years for all oblasts was equal to 15.9. There is no difference between the two years: 1985—15.3; 1986—16.6 ($t = 1.408$).

In control group 2 (1987-1989, in oblasts without radioactive fallout), the span of frequencies was within 11.7-40.6, while the average frequency for all oblasts over the three years is equal to 18.1. The mean weighted frequencies in these oblasts were equal to 17.9 in 1987, 17.6 in 1988 and 18.8 in 1989. The difference between these values is insignificant (t within the limits from 0.021 to 0.922).

In the irradiated group (1987-1989, Zhitomir and Kiev oblasts), the span of frequencies was from 17.8 to 26.1. The average frequency for this group was 18.5 in 1987, 20.6 in 1988, 25.5 in 1989, and 21.5 for the three years. The increase in frequency of births of children with congenital developmental defects noted from one year to the next is significant ($\chi^2 =$ from 5.4 to 53.9).

On the basis of statistical analysis of Table 3 as a whole, we can arrive at general conclusions from a comparison of the frequency of births of children with congenital developmental defects in different oblasts in different years. On checking the frequencies for uniformity, we found it possible to combine indicators into single samples for all three groups. The following was revealed by comparing average values between groups. The differences between control group 1 and control group 2 as well as between groups 1 and 3 (irradiated) are highly significant ($t = 4.55$ and 3.84 respectively); on the other hand the differences between group 2 and group 3 are insignificant ($t = 0.94$). This is an

indication that a significant difference does exist with respect to the time factor (groups 1 and 2), but there is no significant difference for the irradiation factor (groups 2 and 3). Naturally this effect was detected in both Kiev and Zhitomir oblasts. The difference between 1985-1986 on one hand and 1987-1989 on the other is significant in relation to both Kiev Oblast ($\chi^2 = 5.04$) and Zhitomir Oblast ($\chi^2 = 38.57$). However, because a significant difference also exists in relation to unirradiated oblasts, this is an indication either of change in registering congenital developmental defects, or of some other factor, but not that they are radiation-induced. There are no grounds for thinking that some dramatic change associated with chemical influences had occurred precisely in 1986 over the entire Ukrainian territory. At the same time until the reporting of medical statistics and possible sources of more precise registration beginning in 1987 are analyzed objectively, we cannot conclusively correlate the temporal difference in the frequencies of congenital developmental defects with the procedure by which they were registered.

Higher indicators for the frequency of births of children with congenital developmental defects in 1989 in Zhitomir and Kiev oblasts (see Table 3) in comparison with preceding years cannot be explained as yet by a mutagenic or teratogenic effect that had been absent previously. No fundamental changes of any sort occurred in the radiation situation in 1988 (see Table 1). Such "increases" in frequencies in 1989 were detected (see Table 3) in oblasts without radioactive fallout as well (Ternopol and Khmelnytskyi); they also occurred in other years in other oblasts. As a rule, such results are explained by a combination of stochastic processes determining development of congenital developmental defects and changes in registration accuracy.

It follows from world data on the total frequency of congenital developmental defects that these values are close on the average in different countries and populations. Only certain forms (cerebrospinal hernias, congenital dislocation of the femur) are encountered in some countries with

higher frequency⁹. The main difficulty in assessing differences in frequencies of congenital developmental defects is associated with unstandardized diagnostic and recording methods. A unified international register is maintained only for certain forms (up to 20 nosological units)¹⁵.

Accounting of congenital developmental defects over Ukrainian territory could hardly be called unified. The accuracy of their recording in different oblasts is unknown. We can suppose from data in Table 3 analyzed statistically that differences exist in the criteria by which congenital developmental defects are accounted for. Thus, the frequency of births in Zaporozhye, Crimean, Lvov, Nikolayev and Odessa oblasts is twice lower than in Sumy and Chernigov oblasts and in Kiev. It is hard to find any rational biological, population-based or ecological explanation for these differences. Considering the above, not only do we need to continue observing possible genetic and teratogenic consequences of the accident at the Chernobyl Nuclear Power Plant, but we also need to unify accounting of congenital developmental defects in accordance with

the rules of the international register, which has entered the public health practice of developed countries.

According to data of the UN Scientific Committee on the Effects of Atomic Radiation¹⁸, the increase in the number of patients with hereditary problems, including with congenital developmental defects, resulting from irradiation of parents at a dose of 0.01 grays (total for both) is 0.006 percent in the first generation. This means that one child will be born with a congenital developmental defect resulting from irradiation of its parents for approximately every 16,000 newborn infants, among which there will be 500-1,000 children with hereditary diseases and congenital developmental defects. Inasmuch as every resident of Kiev and Zhitomir oblasts received an average of 0.5 cZw in 1986 and a little more in subsequent years, the number of children with congenital developmental defects in each oblast may increase by not more than one or two infants. Each year 500-600 children are born in these oblasts with congenital developmental defects. This "increment" is in fact very hard to detect in statistical data.

Table 4. Frequency of Spontaneous Abortions (per 1,000 Pregnancies)

| | | | | | | |
|--------------------|------|------|------|------|------|------|
| Vinnitsa | 38.1 | 39.3 | 40.3 | 40.4 | 36.3 | 38.9 |
| Volyn | 33.8 | 37.9 | 25.3 | 28.3 | 29.0 | 31.0 |
| Lugansk | 53.7 | 54.0 | 51.0 | 51.0 | 48.7 | 51.8 |
| Dnepropetrovsk | 39.9 | 38.1 | 40.1 | 38.9 | 41.2 | 39.6 |
| Donetsk | 44.7 | 45.3 | 44.6 | 46.3 | 44.4 | 45.1 |
| Zhitomir | 22.3 | 23.9 | 25.4 | 27.5 | 34.2 | 26.5 |
| Transcarpathian | 38.7 | 50.4 | 44.7 | 42.8 | 45.6 | 44.5 |
| Zaporozhye | 43.0 | 44.4 | 42.2 | 44.0 | 48.0 | 44.2 |
| Ivano-Frankovsk | 15.5 | 22.0 | 29.8 | 22.6 | 22.9 | 22.6 |
| Kiev | 41.0 | 41.5 | 41.8 | 41.7 | 44.0 | 41.9 |
| Kirovograd | 43.0 | 44.8 | 46.3 | 42.8 | 42.2 | 43.9 |
| Crimean | 55.4 | 53.3 | 52.6 | 50.1 | 46.2 | 51.7 |
| Lvov | 30.0 | 27.0 | 27.6 | 26.9 | 23.5 | 27.1 |
| Nikolayev | 39.5 | 34.2 | 35.0 | 40.6 | 48.1 | 39.2 |
| Odessa | 45.8 | 44.0 | 47.0 | 44.8 | 45.5 | 45.4 |
| Poltava | 39.4 | 40.1 | 38.8 | 39.5 | 37.4 | 39.1 |
| Rovno | 23.6 | 24.5 | 28.8 | 28.1 | 26.5 | 26.3 |
| Sumy | 40.7 | 42.8 | 41.3 | 37.6 | 40.5 | 40.6 |
| Ternopol | 30.1 | 29.5 | 25.8 | 26.1 | 22.9 | 27.0 |
| Kharkov | 35.1 | 33.6 | 35.3 | 37.1 | 37.9 | 35.7 |
| Kherson | 36.5 | 40.0 | 37.2 | 41.0 | 40.7 | 39.0 |
| Khmelnitskiy | 30.6 | 33.9 | 32.2 | 33.4 | 33.9 | 32.8 |
| Cherkassy | 38.8 | 39.5 | 42.1 | 36.5 | 42.4 | 39.8 |
| Chernovtsy | 33.4 | 30.0 | 34.3 | 29.0 | 32.3 | 31.8 |
| Chernigov | 27.3 | 32.1 | 34.5 | 39.3 | 37.5 | 34.0 |
| Kiev | 25.6 | 27.1 | 27.3 | 23.8 | 25.5 | 25.8 |
| Sevastopol | 44.1 | 53.0 | 56.6 | 50.4 | 47.5 | 50.4 |
| Ukraine as a whole | 37.7 | 38.6 | 38.7 | 38.1 | 38.4 | 38.3 |

If we analyze the frequency of spontaneous abortions (Table 4) on the basis of the principle of congenital developmental defects, we find that there are no differences between the groups (t is within 0.409-0.652). The frequency of spontaneous abortions based on official medical statistics varies by two to three orders of magnitude both in radioactively contaminated and in uncontaminated oblasts (see Table 4). Thus, their frequency varies by two orders of magnitude over five years in oblasts without radioactive contamination: Rovno—26.3 per 1,000 pregnancies, Crimean and Lugansk—almost 52 per 1,000. In radioactively contaminated oblasts, while the radiation load is relatively uniform (see Table 1), the average frequency for the radioactive period (1987-1989) differs strongly: Zhitomir—29.0; Kiev—42.5. In this case while in Kiev Oblast the frequency of spontaneous abortions did not change after the Chernobyl accident, in Zhitomir Oblast it increased ($\chi^2 = 38.99$). However, despite this increase, it is almost twice lower than in Kiev Oblast. Obviously in this case the differences are the product of differences in recording accuracy, and not of the actual frequency of the events. Analysis of Soviet and foreign literature^{10,17} shows that the frequency of spontaneous abortions averages not 30-50 per 1,000 pregnancies (as reported in medical statistics of the Ukrainian SSR Ministry of Health), but 100-150 per 1,000 pregnancies. Other than methodological differences in accounting for spontaneous abortions, there could hardly be any other explanation for the twofold difference of this indicator in the two Russian regions, which were examined in the same years by different authors^{3,8}. Given such accounting inaccuracy and the absence of unified methods of diagnosing spontaneous abortions, this indicator cannot as yet be used to assess the mutagenic effects of small radiation doses and chemical influences¹³.

Conclusions

1. Differences in the average frequencies of congenital developmental defects before 1987 and beginning in 1987 are statistically significant both in the oblasts that experienced radioactive fallout (Zhitomir and Kiev) and in all others—that is, the differences are determined by the time factor, and not by the irradiation factor.
2. According to official medical statistics, the frequency of births of children with congenital developmental defects varies in different oblasts of the Ukraine in 1985-1989 between 5.9 and 40.6 per 1,000 newborn infants, with an average of 18.0 per 1,000. No sensible biological, population-based, genetic or ecological explanation was found for the existing differences. The system of unified accounting of congenital developmental defects adopted by the international register must be introduced.
3. The level of variations in the frequency of congenital developmental defects is so great according to official statistics that small increases in this indicator resulting from the mutagenic or teratogenic action of ionizing radiation or chemical substances cannot be evaluated.
4. According to medical statistics the frequency of spontaneous abortions is from 26 to 52 per 1,000 pregnancies, which is two to three times lower than the actual level. It is

hypothesized that the differences are the product of different recording accuracy. Using statistics on spontaneous abortions to evaluate the mutagenic effects of the Chernobyl Nuclear Power Plant accident is not recommended.

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36

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